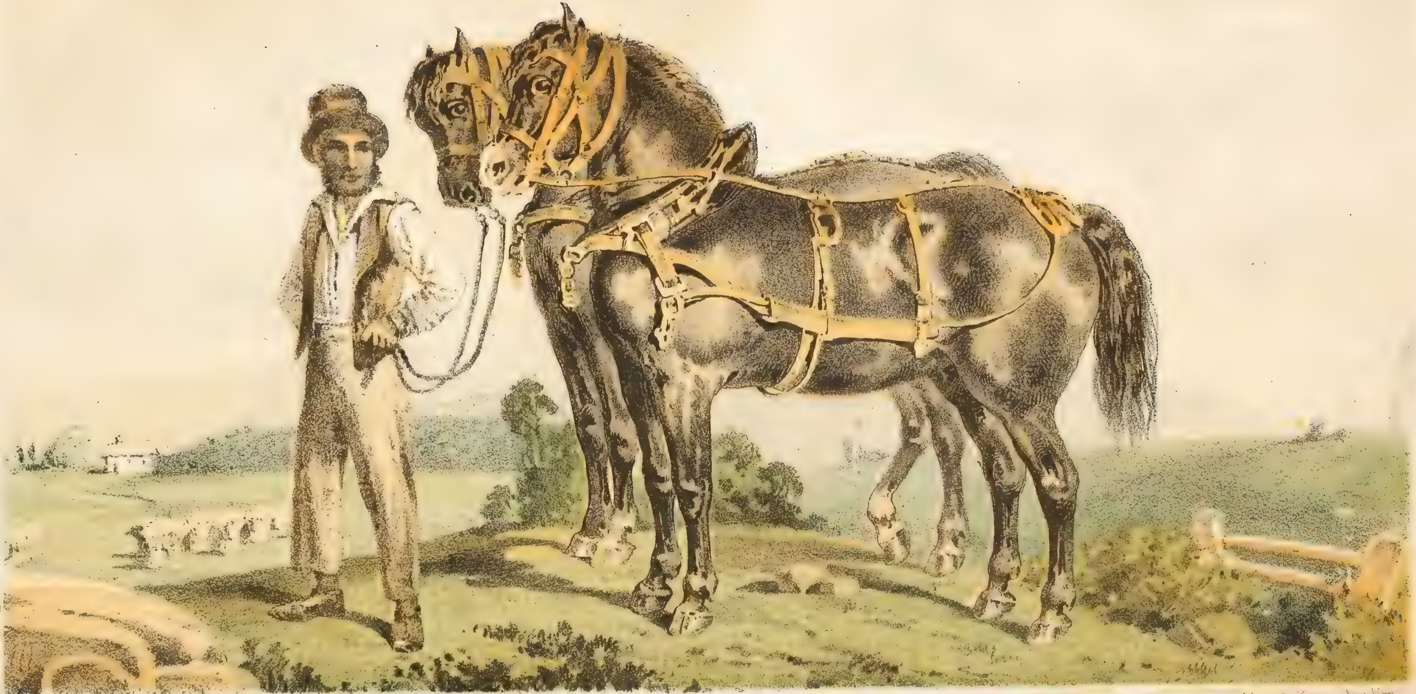


Amb^d by S. Walther Washington

Lith. of Sarony, Major & Knapp, New York

ARDEN HORSES.

PLATE II

Lith of Sarony, Major & Knapp. 449 Broadway N. Y.

SOUTH DOWN SHEEP.

FROM THE FLOCK BELONGING TO THE LATE JOHN ELLMAN, ESQ.

PLATE III

ISOTHERMAL LINES IN NORTH AMERICA, AS DETERMINED BY THE SMITHSONIAN INSTITUTION.

Pl. V.

LARGE-TAILED FOX-SQUIRREL.

FOX-SQUIRREL OF PENNSYLVANIA.

MIGRATORY, OR COMMON GREY AND BLACK SQUIRREL

BLACK SQUIRREL.

LITTLE RED-SQUIRREL.

COMMON FLYING SQUIRREL.

STRIPED GROUND SQUIRREL, OR CHIPMUCK.

STRIPED AND SPOTTED PRAIRIE-SQUIRREL.

GREY PRAIRIE-SQUIRREL.

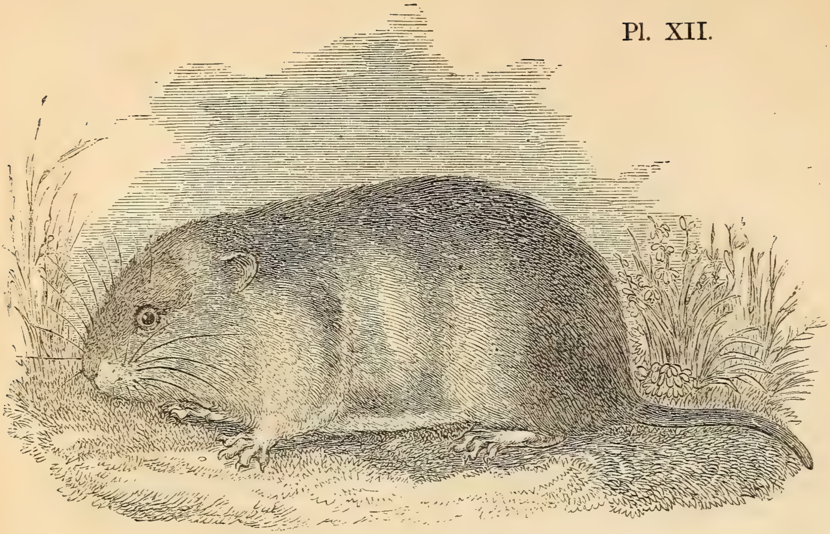
PRAIRIE-DOG.

WOOD-CHUCK, OR GROUND-HOG.

COMMON WHITE-FOOTED WOOD-MOUSE.

WHITE-FOOTED PRAIRIE-MOUSE.

LONG-TAILED JUMPING MOUSE.



PRAIRIE MEADOW-MOUSE.

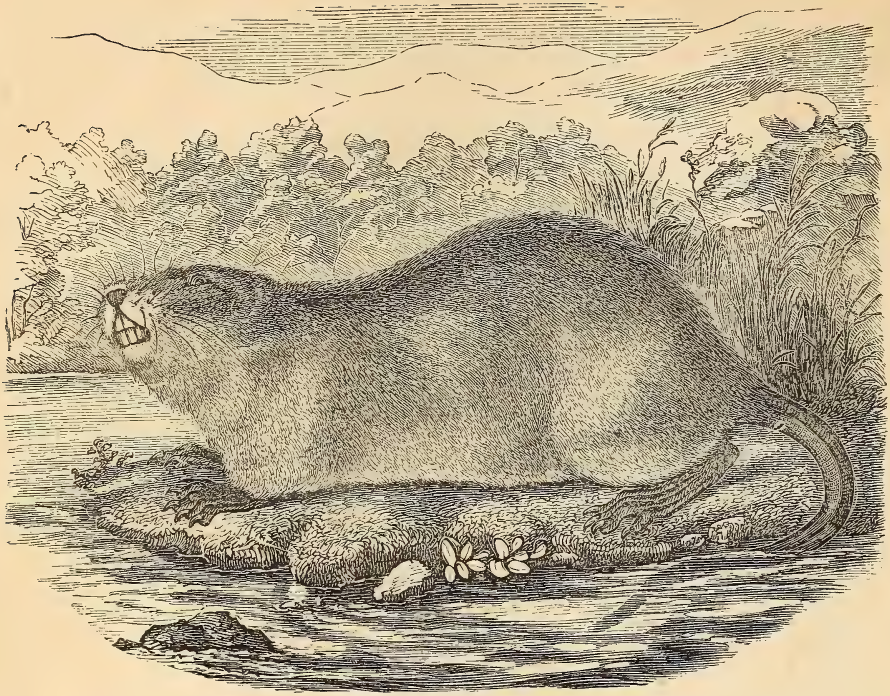
WOOD MEADOW-MOUSE.

Pl. XIII.

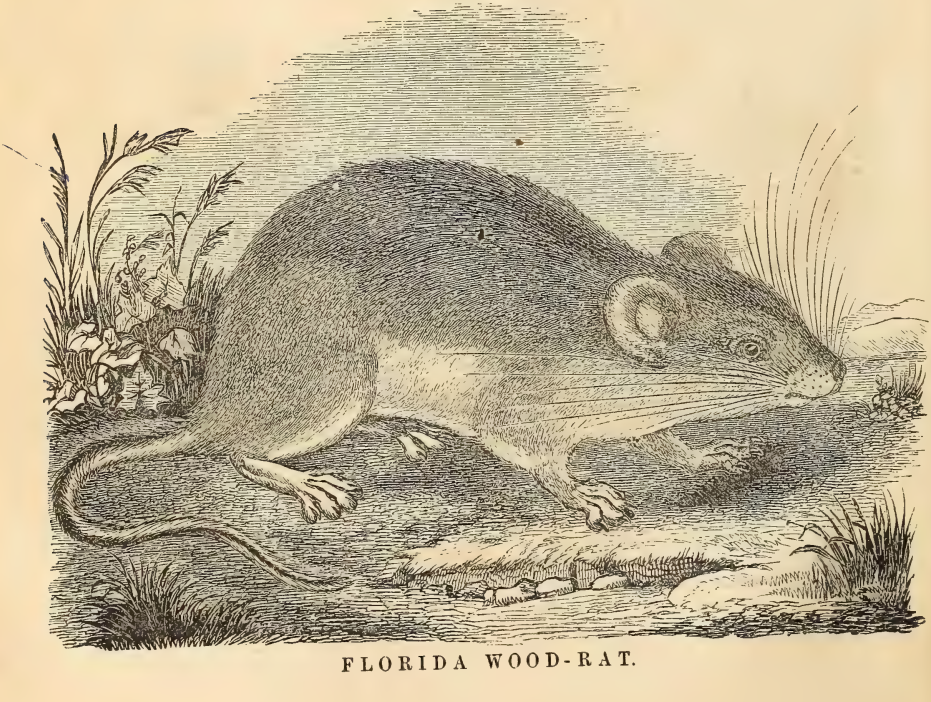
LONG-HAIRED MEADOW-MOUSE.

(MALE.)

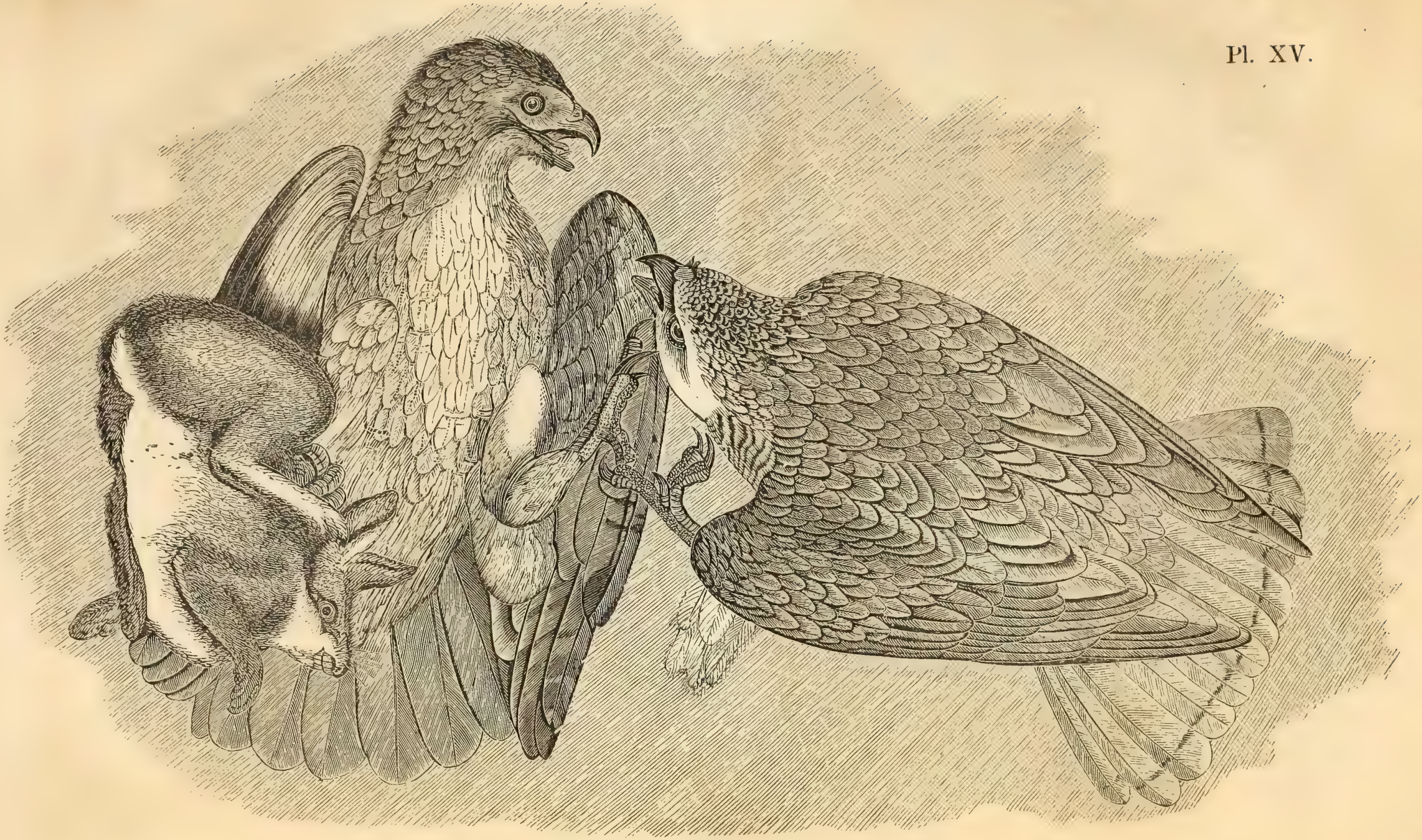
(FEMALE.)



MUSKRAT.



FLORIDA WOOD-RAT.



RED-TAILED BUZZARD.

Pl. XVI.

HARLAN'S BUZZARD.

Pl. XVII.

BROAD-WINGED BUZZARD.

Pl. XVIII

WHITE-HEADED OR BALD EAGLE.

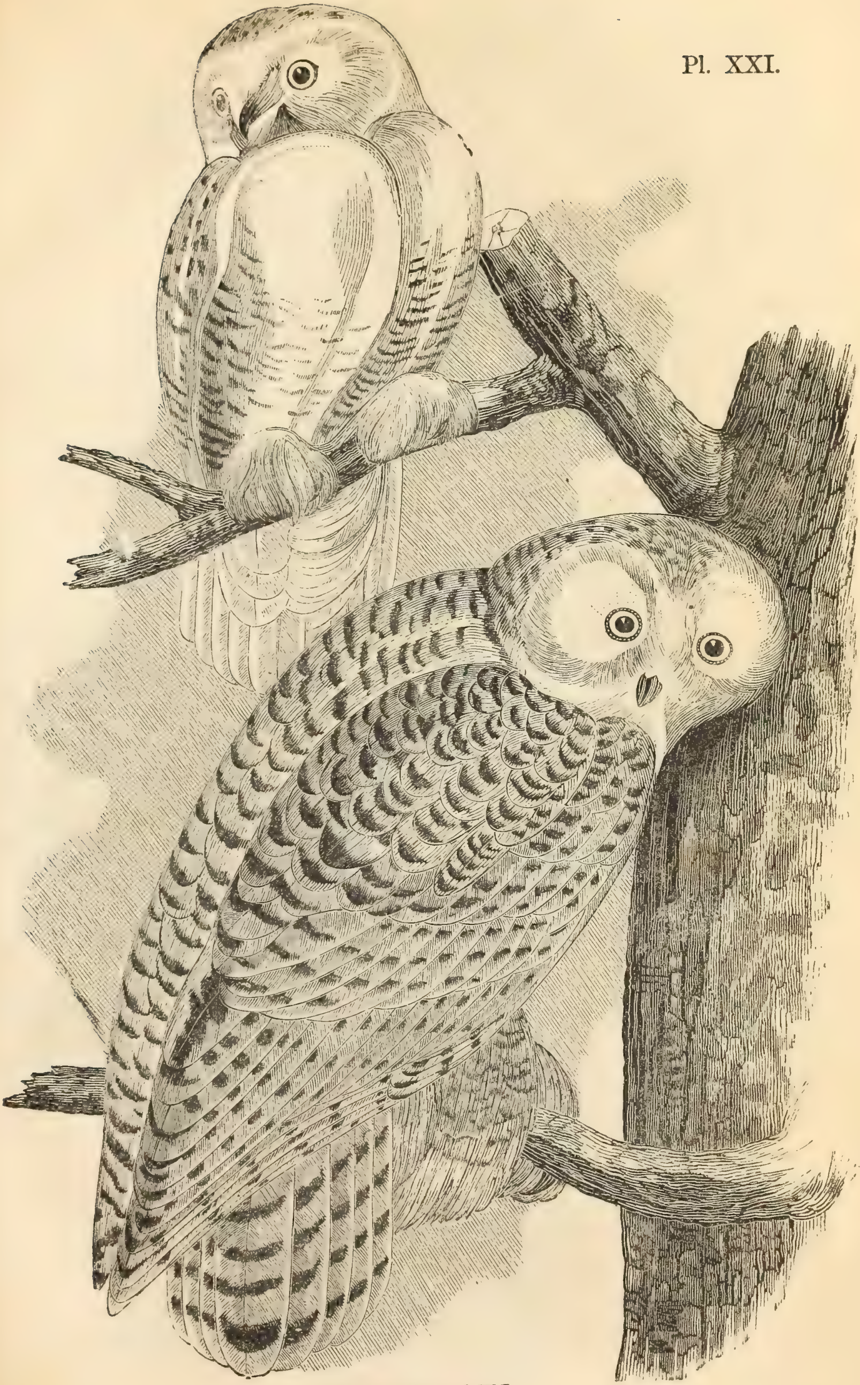
Pl. XIX.

LARGE-FOOTED HAWK.

Pl. XX.

SHARP-SHINNED HAWK.

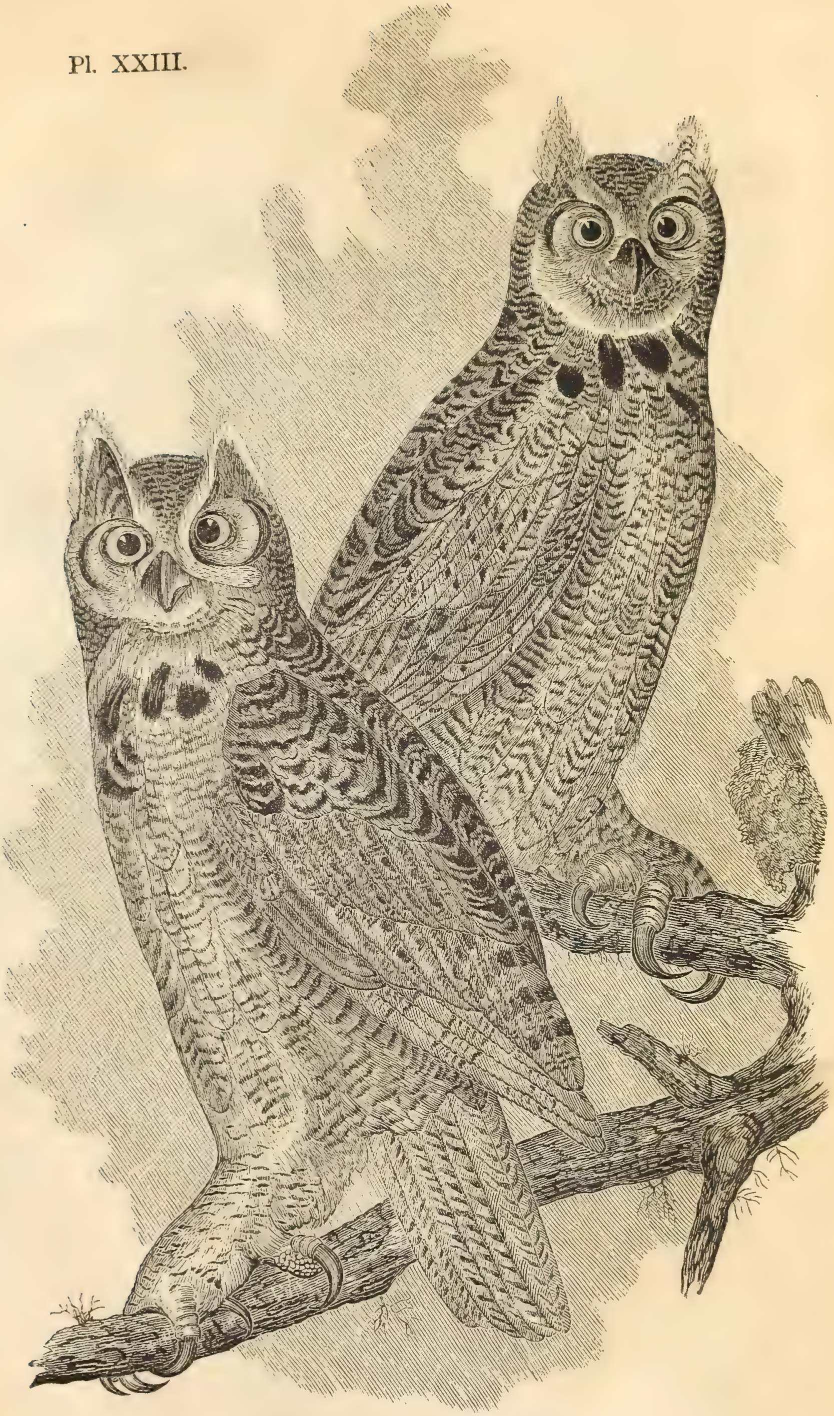
Pl. XXI.



SNOWY OWL.

BARRED OWL.

Pl. XXIII.



LARGE-HORNED OWL.

Pl. XXIV.

KING-BIRD.

Pl. XXV.

BLUE-GROSBEAK.

Pl. XXVI.

ROSE-BREASTED GROSBEAK.

Pl. XXVII.

REED BIRD, OR BOB-O-LINK.

Pl. XXVIII.

RED-WINGED STARLING.

Pl. XXIX.

ORCHARD ORIOLE.

Pl. XXX.

CROW-BLACKBIRD.

Pl. XXXI.

PURPLE-GRACKLE.

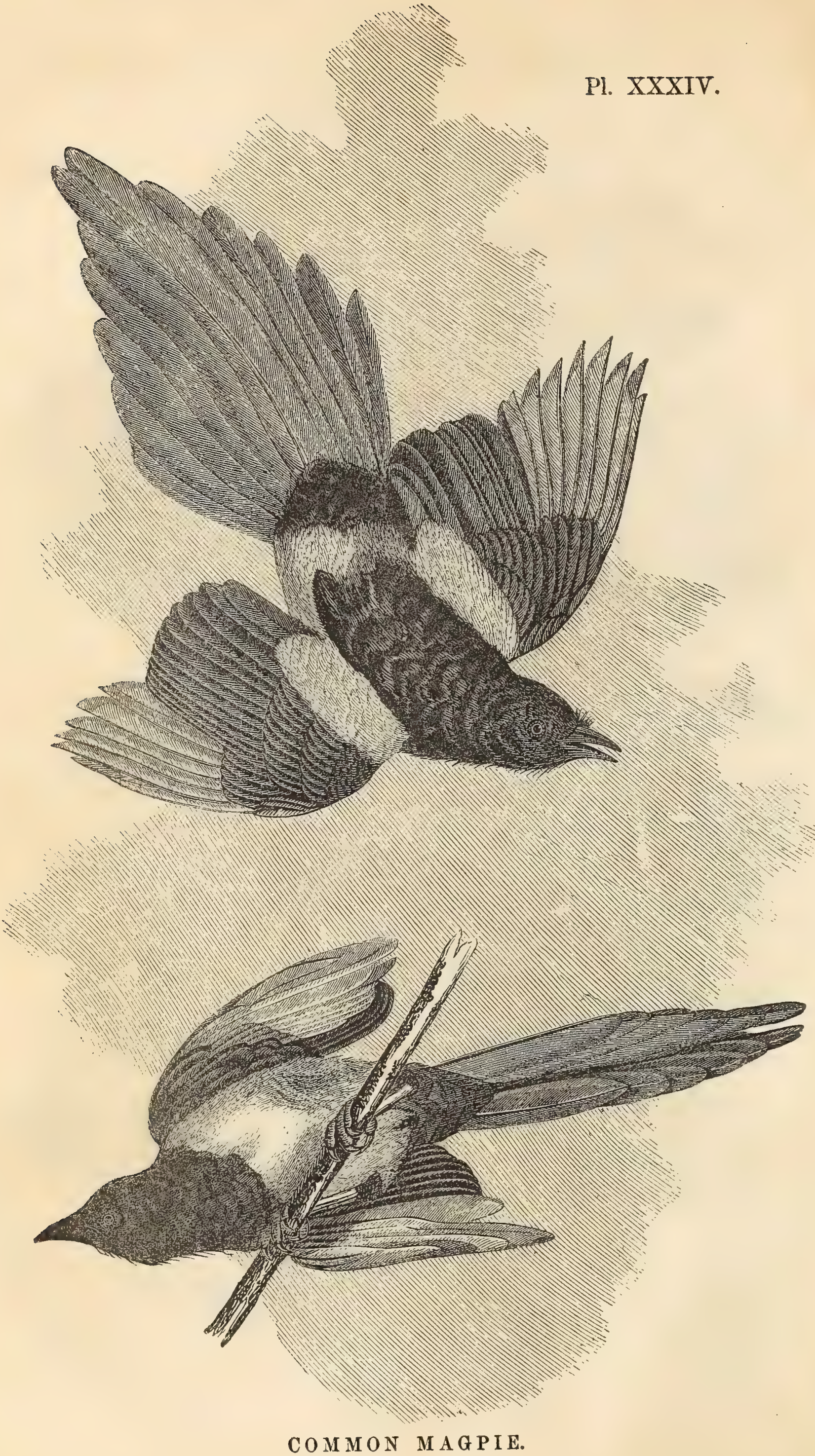
Pl XXXII.

COMMON CROW.

Pl. XXXIII.

FISH-CROW.

Pl. XXXIV.



COMMON MAGPIE.

Pl. XXXV.

BLUE-JAY.

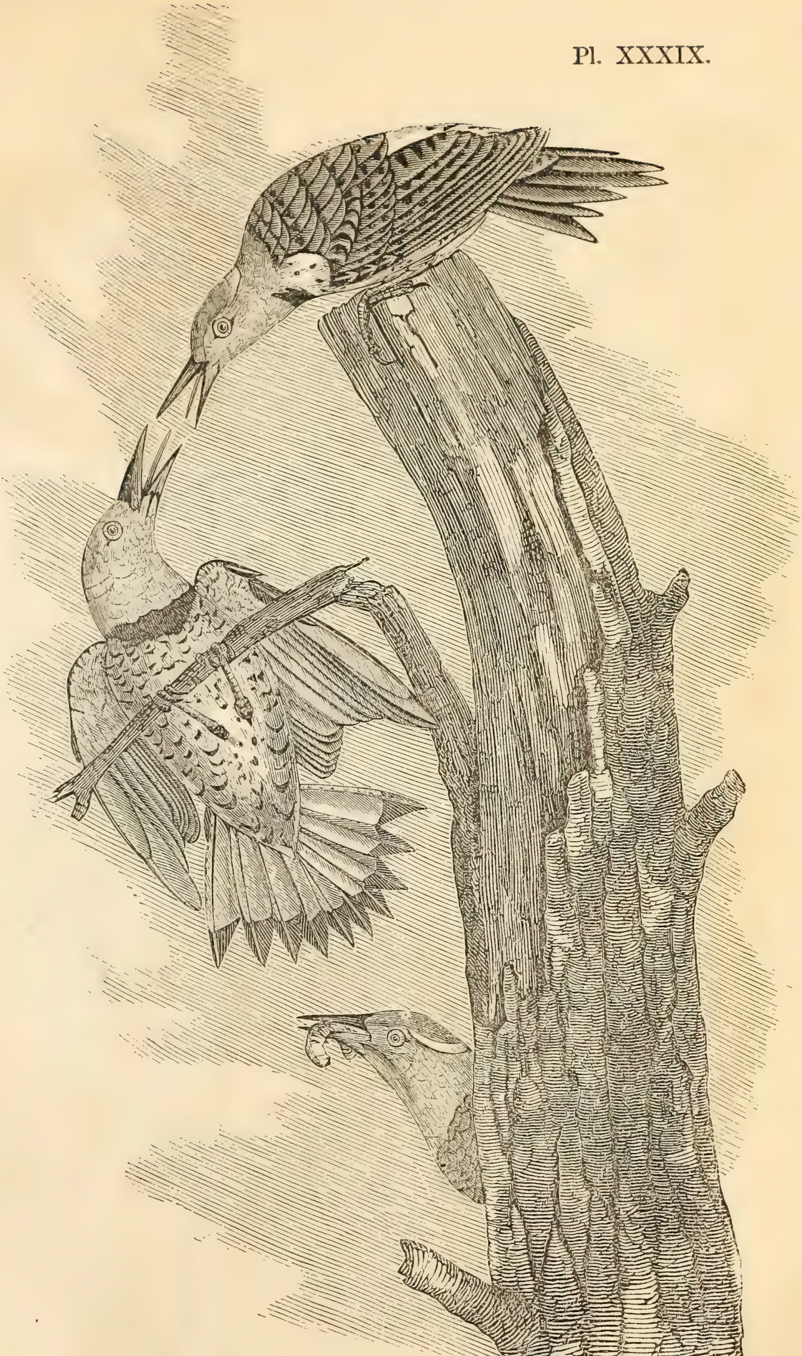
Pl. XXXVI.

GREAT AMERICAN SHRIKE.

HAIRY WOOD-PECKER

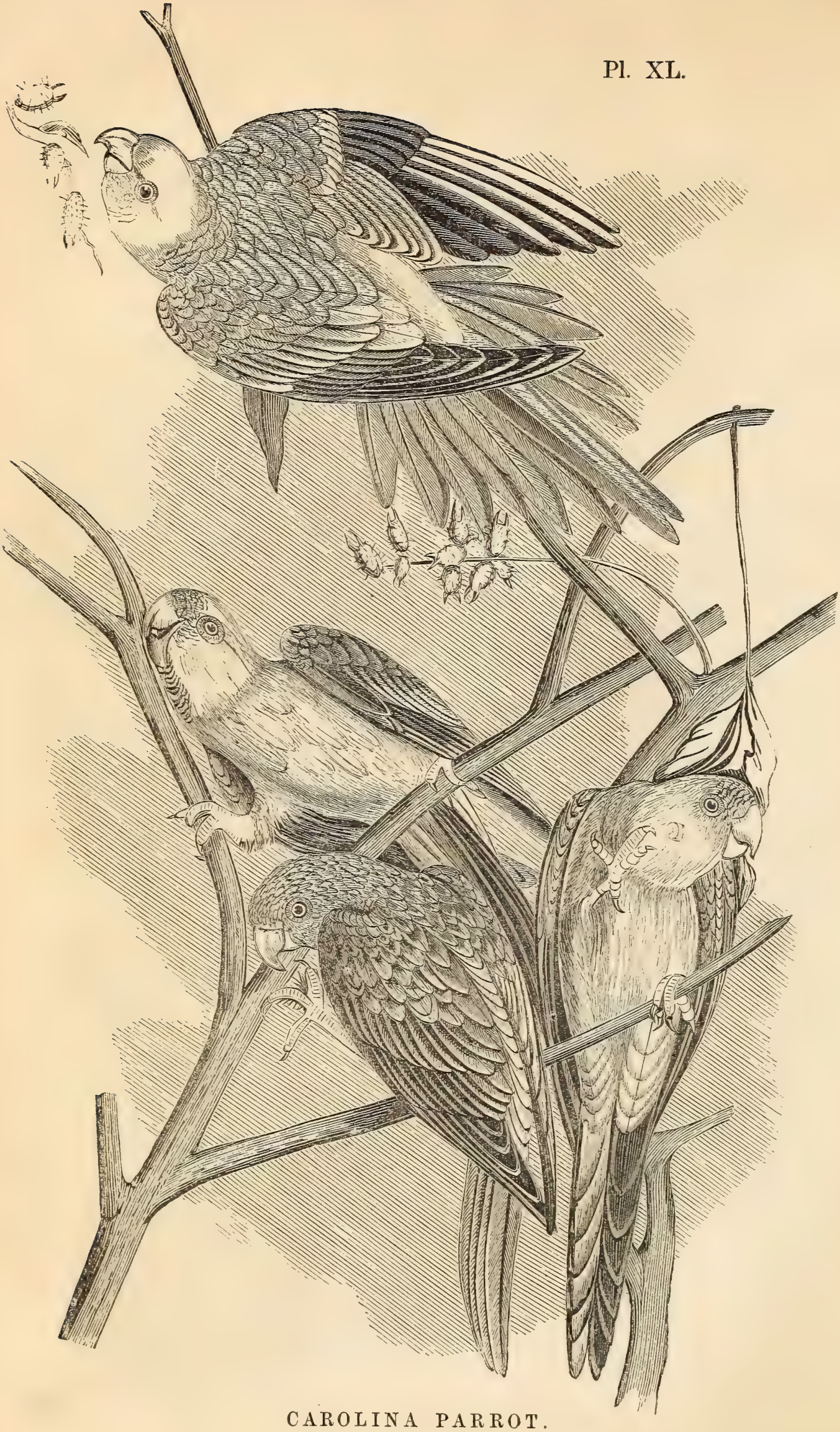
RED-HEADED WOOD-PECKER.

Pl. XXXIX.

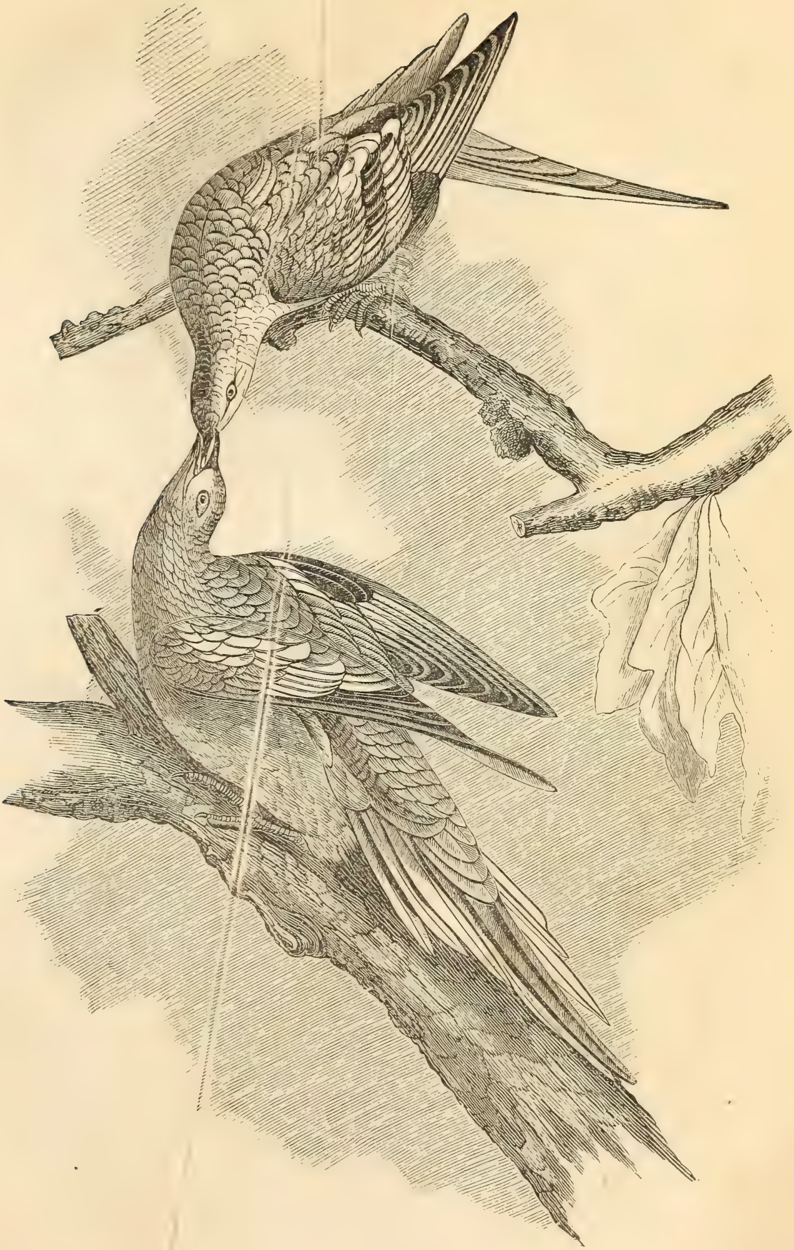


GOLDEN-WINGED WOOD-PECKER.

Pl. XL.



CAROLINA PARROT.



PASSENGER PIGEON.

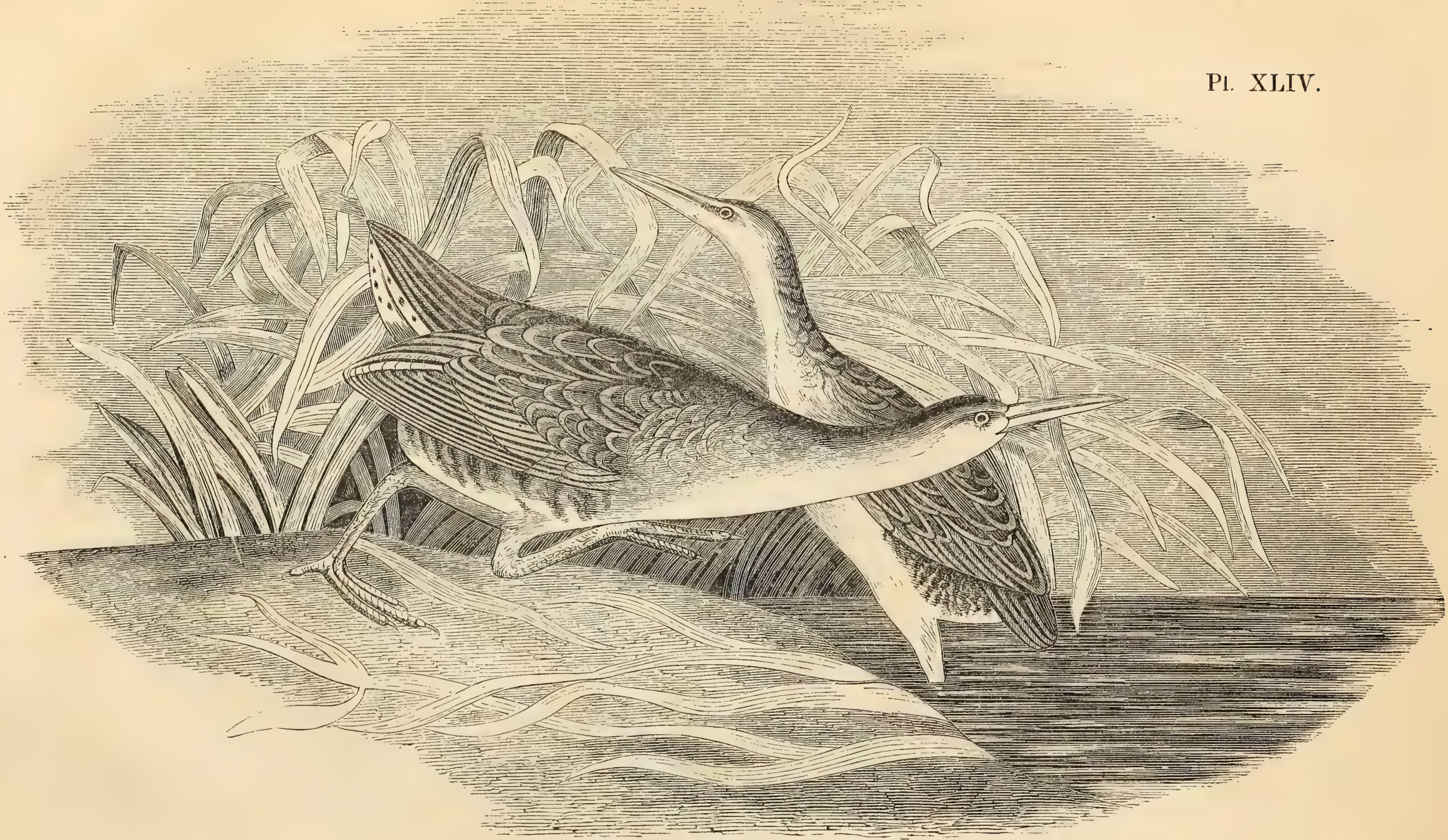
Pl. XLII.

RUFFED GROUSE.

Pl. XLIII.

SPOTTED OR CANADA GROUSE.

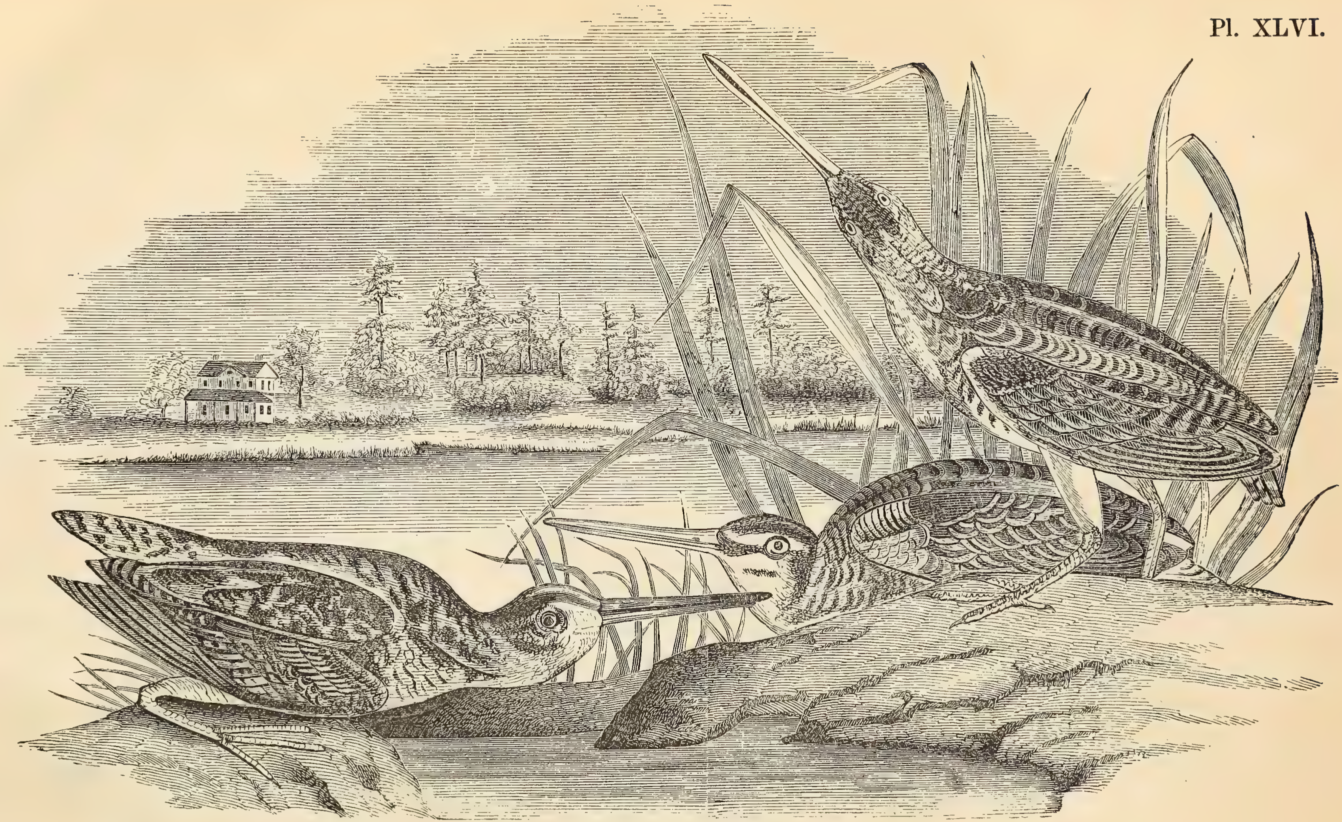
Pl. XLIV.



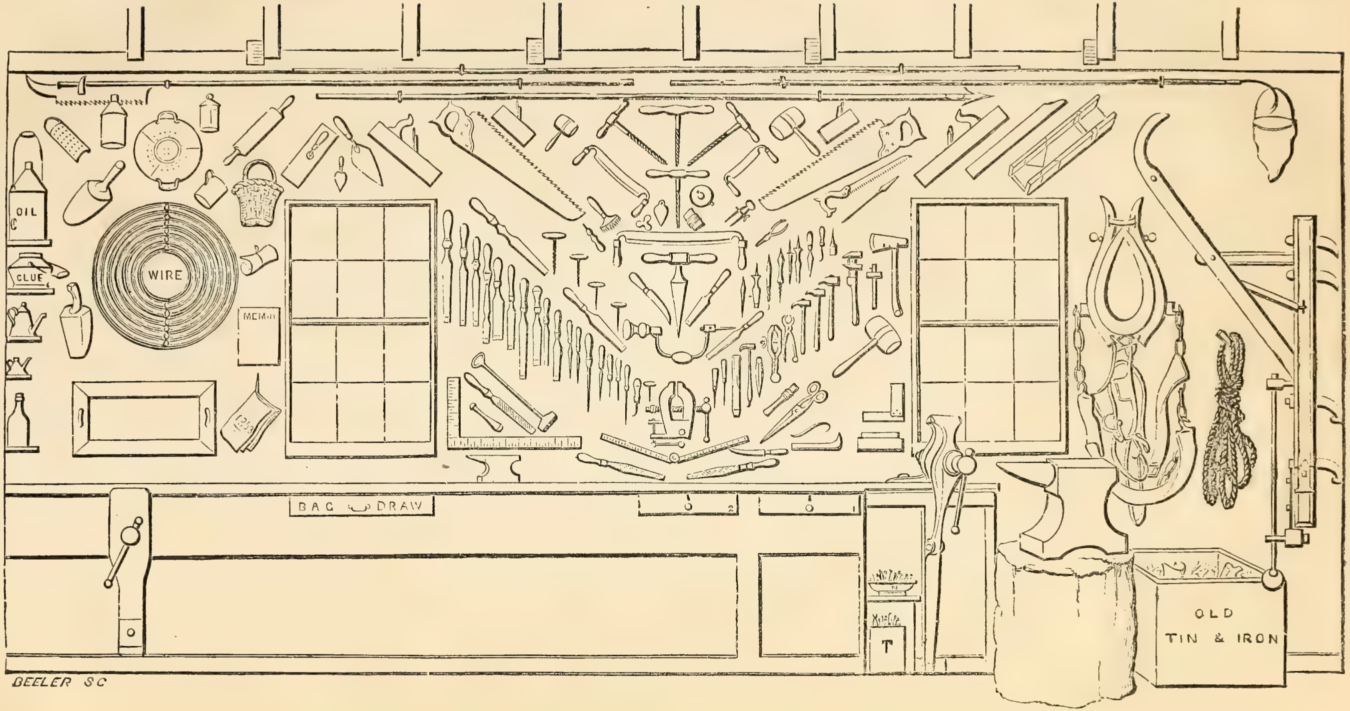
GREAT RED-BREASTED RAIL.

WHOOPING CRANE.

Pl. XLVI.

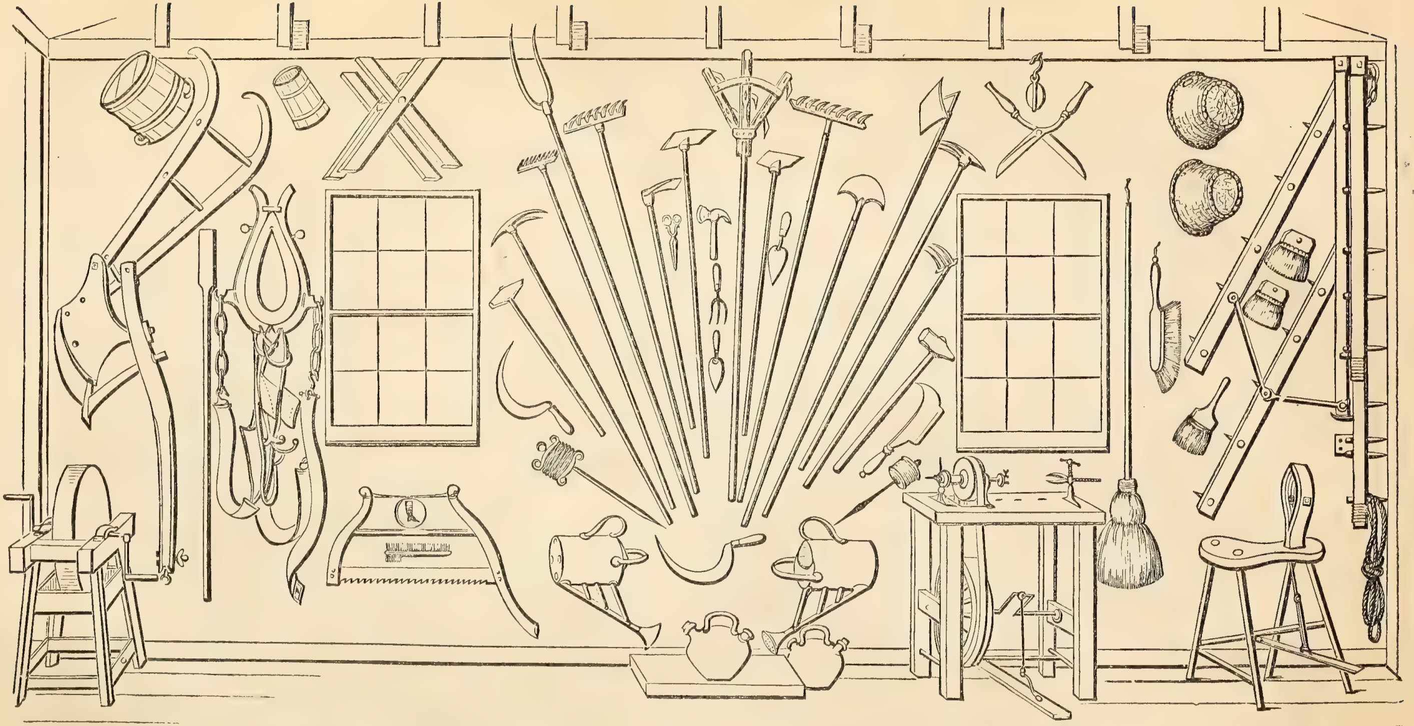


WILSON'S SNIPE.

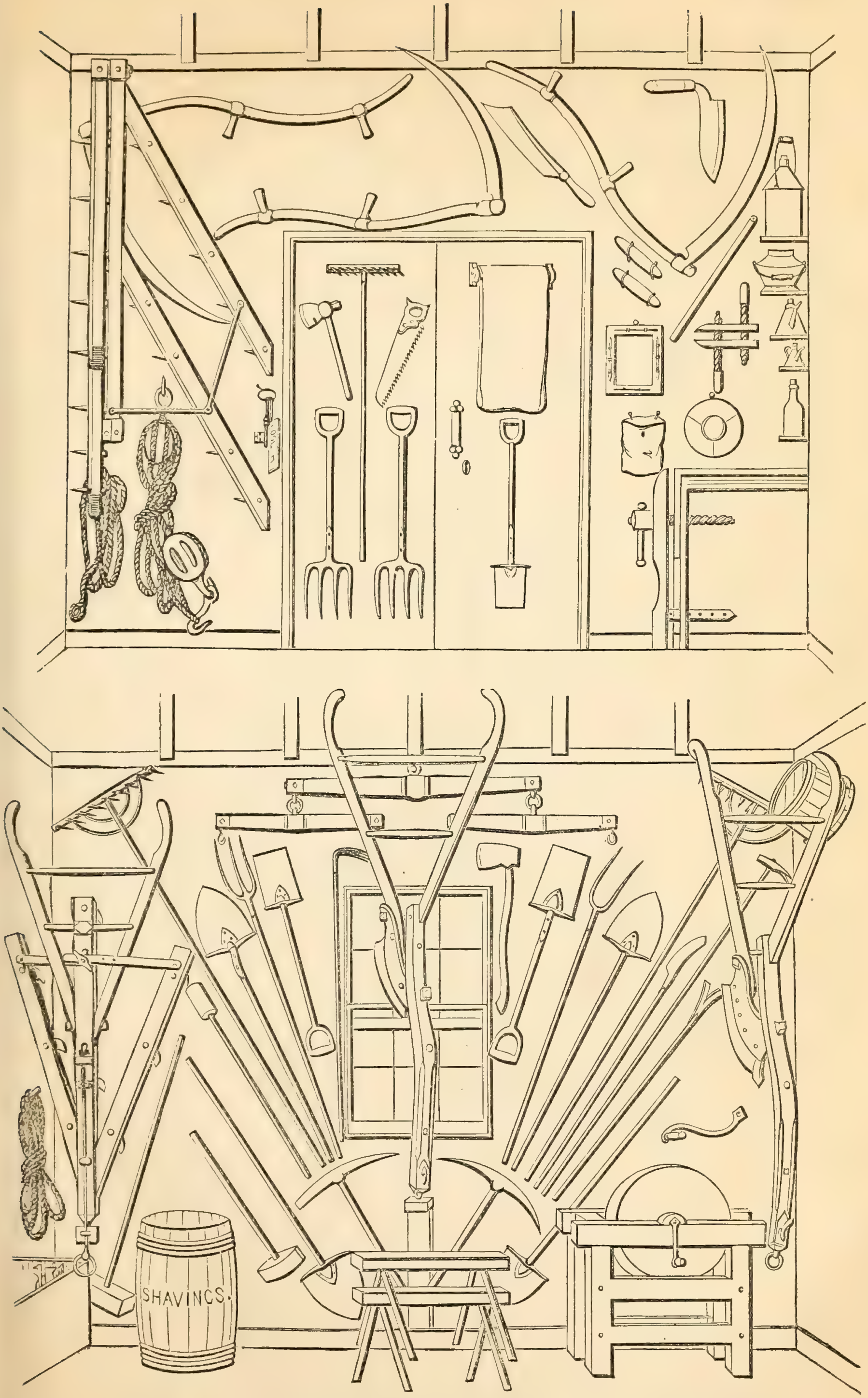


VIEW OF ONE SIDE OF INTERIOR OF A TOOL-HOUSE.

Pl. XLVIII.

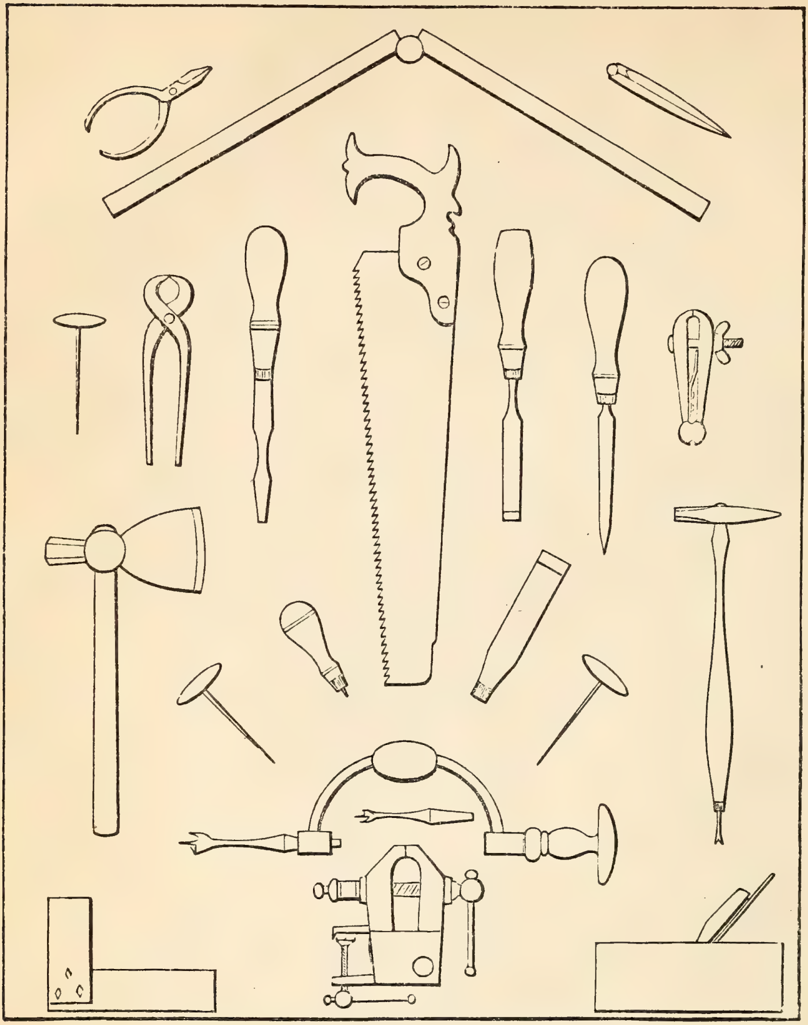


VIEW OF OTHER SIDE OF INTERIOR OF A TOOL-HOUSE.



VIEW OF ENDS OF INTERIOR OF A TOOL-HOUSE.

A SEPARATE PLACE FOR EACH THING, AND EVERY THING IN ITS PLACE.



TOOL-CLOSET FOR FAMILY USE.

34th Congress, 3d Session. | SENATE. | Ex. Doc. No. 53.

REPORT

OF THE

COMMISSIONER OF PATENTS

FOR THE YEAR 1856.

AGRICULTURE.

WASHINGTON:
A. O. P. NICHOLSON, PRINTER.
1857.

IN THE SENATE OF THE UNITED STATES, *February* 25, 1857.

Resolved, That there be printed for the use of the Senate fifty-five thousand extra copies of the Report of the Commissioner of Patents on Agriculture for the year 1856, two thousand of said copies to be for the use of the Patent Office; and that the Commissioner of Patents be authorized to add to the portion of his report now before the Senate such matter as may be necessary to complete the same: *Provided,* That such additions shall not exceed, in the aggregate, the number of pages contained in the report on the same subject for the year 1855. *And provided further,* That the entire amount of copy necessary to complete said report be placed in the hands of the public printer by or before the first day of May next; but no portion of said copy shall be placed in the hands of the public printer until the whole shall have been completed and delivered into the hands of the Superintendent of the Public Printing.

Attest:

ASBURY DICKINS, *Secretary.*

UNITED STATES PATENT OFFICE,
February 18, 1857.

SIR: Agreeably to the design of Congress, as indicated by the appropriation of August 18, 1856, "for the collection of agricultural statistics, investigations for promoting agriculture and rural economy, and the procurement and distribution of cuttings and seeds," I have the honor herewith to transmit the Agricultural portion of my Annual Report.

Very respectfully, your obedient servant,

CHARLES MASON,
Commissioner.

Hon. JAMES M. MASON,
President pro tem. of the Senate.

REPORT

OF THE

COMMISSIONER OF PATENTS.

UNITED STATES PATENT OFFICE,
February 17, 1857.

SIR: The act of the last session, which appropriated seventy-five thousand dollars for agricultural purposes, required some of the items of expenditure to be specifically reported. That report has already been made the subject of a separate communication; but, as it is believed that a more complete statement of the operations of this branch of the Patent Office would be desirable and proper, in connection with the usual Agricultural Report, such a statement is herewith presented for the consideration of Congress.

The following table will exhibit the disposition which has been made of most of the fund appropriated and its present condition:—

Statement showing the balance unexpended of the appropriation of $75,000 *made for agricultural purposes on the* 18*th of August last.*

Amount of appropriation,	------------	$75,000 00
Amount paid for the purchase of seeds, &c,	$18,106 21	
Freight and other expenses,	1,964 64	
Salaries and wages of employees in the preparation of the annual report, and for putting up and distributing the seeds,	17,487 15	
		37,558 00
		37,442 00
Amount, as near as can be estimated, *to be paid* for seeds, &c., already ordered,	3,338 12	
From which deduct the amount in the hands of the agent of the office for the purchase of sugar-cane,	10,000 00	
		13,338 12
Balance unexpended,	------------	24,103 88

It is impossible to state with precision how large an expenditure will be requisite during the remainder of the present fiscal year; but

from the best estimates we are now able to form, the whole amount on hand will not be much more than sufficient for this purpose. If it be desirable to continue the operations of the Agricultural Division of this Office during the ensuing year, a new appropriation will be necessary.

A considerable portion of the money now on hand will be needed to pay for seeds intended for distribution next season. As these will mostly come from Europe and Asia, they must be ordered soon, so as to be received in proper time. The necessity of appropriating money for this purpose a year in advance is therefore evident; for the purchases can never be made in season, if the previous action of Congress at its long sessions shall be necessary.

Immediately after the passage of the appropriation bill of the last session, a considerable quantity of several varieties of wheat was ordered from various countries. These were mostly bordering on the Mediterranean, former experience having justified the expectation that wheat from those regions would prove highly useful when introduced here. It was hoped that this grain might arrive in season for fall-sowing, but it has not all arrived even yet, and must now be reserved for use the ensuing season.

In this particular, therefore, we are sufficiently provided with seeds for another year; but there are various other kinds, the procurement of which will absorb a large portion of the means now on hand. This, together with the cost of packing and distributing, will probably leave very little, if any, of the present unexpended balance after the end of the current fiscal year.

Nothing very remarkable has been effected, during the past year, in the way of introducing new seeds and plants. Quite a number has been received, but their merits have not yet been tested. Our Minister to China has been requested to procure new seeds and plants from that country, and is authorized to draw on this Office for an amount not exceeding one thousand dollars to defray the consequent expenses. This course was adopted in the hope that new and useful products might thereby be obtained. Nothing important has as yet been heard from him, but we are daily in expectation of learning something of interest from that quarter.

From the known similarity of the climate of our country to that of China and other regions of Eastern and Central Asia, all products indigenous there, may be expected to thrive here; and from our

general ignorance of those countries in other respects, they have long been regarded by this Office with great interest as being an unexplored region, probably rich in agricultural products of strange and rare varieties, many of which might reasonably be expected to prove highly valuable.

This view was presented by the undersigned in the Agricultural Report for the year 1854. The agent who visited Europe during the autumn of that year, for the purpose of procuring seeds, tubers, and cuttings of new agricultural products, and of choice varieties of those before known, was directed to have a special care to secure those of Chinese or other Eastern origin as far as practicable. The Chinese yam and the Chinese sugar-cane were among the products procured by him, in accordance with these suggestions. The value of the former is still debatable. Experience has hardly yet enabled us to pronounce definitively in relation to it. But, with regard to the sugar-cane, its utility is hardly doubtful. Without suffering ourselves to be carried away by any extravagant expectations on this subject, we may safely say that it will be found highly useful as a forage plant. There seems also a reasonable probability that it will furnish almost every portion of the United States with means of producing, economically, all the sugar, or at least the syrup, which may be needed for domestic consumption, and even, perhaps, much for exportation.

Steps have been taken the past season to supply the means to extend the cultivation of this product into every portion of the country. The Office procured, in the first instance, one hundred and seventy-five bushels of the seed which had been grown in this neighborhood; but, finding that the demand was far from being supplied, one hundred bushels more have been recently ordered from France. As every bushel contains seed sufficient to plant more than thirty acres of ground, the whole amount distributed from this Office during the present season will plant more than eight thousand acres, and, as each acre will yield on an average some forty bushels of seed, there will probably be grown during the present year enough to plant more than ten millions of acres, in 1858, should it all be harvested for that purpose, and this is independent of all which may be introduced from other sources. The country may, therefore, be reasonably expected to be fully supplied with this seed after the present season, and further distributions thereof from this Office will not be necessary.

Much care has also been taken to procure and distribute choice varieties of many other seeds intended for the garden and the field. It has been the special desire and object to provide and place within the reach of the people, wherever scattered, the means of propagating such new and improved varieties of plants as they would not otherwise have had access to, and which are adapted to their respective climates. It certainly was never the purpose of Congress to convert this Office into a common seed-store, intended to supply the public at large gratuitously with the means of planting their ordinary vegetable gardens. This fact seems frequently to have been overlooked by applicants to the Office. It requires no little care and discrimination to guard against a growing tendency to this species of abuse. It would not only be overstepping the bounds of propriety, but would be doing injustice to the people at large, if, instead of their being accustomed to depend mainly upon their own efforts for the means of supplying their wants, they should be encouraged to turn their eyes habitually to the government, as a reliance for such purposes. If this were once established as the rule of action, it would be silently but certainly doing much to work a change in the very character of the government itself, by causing it to be regarded in this particular as the fountain of favors and benefits. The people would be gradually parting with that self-reliance which is the parent of energy and the main-spring of success in every undertaking, and which is so necessary to the preservation of individual self-respect, and therefore of personal, and finally of national, independence.

The action of the Office does not seem open to this objection, so long as it confines itself simply to the introduction and dissemination of the seeds of new and improved varieties of plants, while those seeds are disposed of, not for the personal gratification and benefit of individuals, but with a primary purpose of introducing and propagating new and useful products for the public benefit. The recipient of a package of seeds should be regarded, both by himself and others, as an agent who is willing to devote, gratuitously, a certain portion of his time and labor for the public benefit, and who acts under an implied pledge that, should the experiment prove successful, he will, as far as practicable, propagate and distribute, as from a new centre, to all around him.

This view of the matter is often lost sight of by the recipient. It is sometimes ascertained that persons who have been furnished

from this source with the means of raising some choice garden vegetables, finding them excellent, have consumed the whole without a thought for the future, either in regard to their neighbors or even themselves. If this were to be the practice, generally, there would be an impropriety in continuing this system of distribution at public expense.

As an instance of the carelessness and improvidence sometimes exhibited in this respect, the case of the *chufa*, or earth almond, may be cited. Some three years ago, a small supply of these roots was procured from Spain and distributed in the usual manner. The experiment seemed satisfactory, and it appeared highly probable that this plant might become one of our permanent and profitable products. Recently, many requests for the tubers have reached us, but upon inquiry none can be found here. It is not known to have been propagated and to be now in existence in any portion of the country. All which has been raised has, as far as ascertained, been consumed or otherwise destroyed. As there are grounds for believing that a second experiment would produce a different result, another small supply has been ordered from Spain. It will not, however, reach us in time for use the coming season, but can be distributed next winter. If this experiment shall meet with the same result as the former, it is very certain that no further effort should be made to guard against the consequences of such gross improvidence, and a like rule should be followed in all other cases.

The foregoing example must not, however, be regarded as a specimen of the course usually observed in such cases. In individual instances, similar remissness is still exhibited; but there are many persons throughout the country—and their number is annually increasing and becoming better known—who have the proper notions on this subject, and who take a pride and pleasure in conscientiously propagating and distributing whatever is placed in their hands for that purpose. Agricultural societies have also taken the matter systematically in hand. They have placed themselves in communication with this Office, and act in concert with it. Any new agricultural product which is now distributed can, with much certainty, be placed in the hands of persons who will render a good account of it, and bring out all its merits.

As a counterpoise to the efforts which have been made to introduce a sugar-bearing plant into the more Northern States, it was thought

just and expedient to afford to the planters of Louisiana, and those of some of the adjoining States, the means of replenishing the stock of the cane from which sugar had heretofore been solely obtained. The crop in those States has, for some years past, been found to be constantly and rapidly dwindling away. This has been supposed to be attributable to the fact that the cane, having been carried further north than its native and congenial climate, had, in process of time, become in consequence affected and deteriorated. The most obvious remedy appeared to be the introduction of some of the hardier varieties of cane from a more southern climate.

Accordingly, the barque Release, with a sufficient crew, having been placed at the disposal of the Office for this purpose, the amount of $10,000 was set apart for the object above named, and a competent agent was dispatched to South America with suitable instructions on the subject. Recent intelligence enables me to state that the vessel has made a successful voyage, and has returned to New Orleans with a full cargo of cane, and some other plants, intended for cultivation in the southern portion of the Union.

Steps had previously been taken to notify the sugar-planters of the South that, by application at New Orleans in proper time, they would each receive a distributive share of this cane, which was directed to be apportioned among such planters as, by themselves or their agents, should make application therefor, upon the promulgation of a notice to that effect through the newspapers of that city. Fears are entertained that the cane has suffered some injury during the voyage; but, if this is not more considerable than is now supposed, sufficient has been procured to furnish every sugar-planter in the whole country with enough to enable him, in the course of a year or two, to substitute the new and vigorous plant for that which has been heretofore in cultivation. It is hoped that, by these means, and those adopted for the introduction of the Chinese cane, an entire change may be effected in relation to the culture of sugar in the United States.

The Circular intended to call for information relative to the production, manufacture, and consumption of cotton in foreign countries, has elicited many replies, from Consuls and others, which are of great interest and importance. The substance of these will be found embodied in the following pages, to which I beg leave to refer in relation to this and many other matters of interest which are also therein contained.

The plan heretofore pursued, with a view of obtaining meteorological facts, and such deductions therefrom as pertain to agriculture, and which has been in former years prosecuted in connection with the Smithsonian Institution, has been continued, with increasing confidence in its eventual utility. The results will be found embodied in tabular statements in the pages appended to this report, from which practical minds can draw many conclusions of high importance to agriculture, derived from this comparatively new, but highly interesting and useful science.

The chemical analyses of soils, products, manures, &c., the entomological researches, and the botanical investigations, referred to in the last report, have, from various causes mostly beyond the control of this Office, been interrupted, and the designs heretofore intimated have not as yet been carried into execution. It is respectfully submitted whether means sufficient to give full effect to the intention formerly expressed should not be granted.

The practical advantages resulting from the services of an entomologist are now fully recognized. The Patent Office Reports for the past two years leave no doubt on this subject. Those of an analytical chemist, when directed in the proper channel, would be equally certain and decisive. The progress in agricultural improvement is founded, in an eminent degree, upon this science. It intimates to us the adaptation of particular articles of food to the production of particular results in the growth of fat, bone, or muscle, in animals; why certain vegetables thrive on one soil and dwindle on another, while exactly the contrary is sometimes observed in regard to other plants; and what species of manures will supply the defects of any given soil, so as to prepare it for the healthful growth of a particular product. In short, it renders agriculture a science, giving the farmer the sense of sight and the confidence of knowledge, instead of leaving him to grope his way in darkness. He is thereby enabled to arrive at important truths, instead of occasionally stumbling over one by accident.

The services of a botanist have been also contemplated. Though they might be usefully employed in various ways, yet it was intended to direct them principally toward investigations relative to the different grasses.

There is no subject of more importance to the American farmer than the knowledge of the means which shall best enable him to

increase the number and value of his live stock, of which grass furnishes the principal sustenance. It may safely be said that the great defect in our agriculture is the failure to rear the proper number and quality of animals. The experience of England and France sufficiently demonstrates the important truth that, on the same number of acres which are now cultivated in the United States, if the quantity of live stock were doubled, the aggregate quantity of grain produced might also be greatly increased, and without any corresponding increase in expense. The explanation of what seems at first so paradoxical is found in the fact that, in this manner, the land would be kept constantly in better heart. Instead of deteriorating from year to year, as is the case where grain alone is the principal product, if a proper proportion of live stock were reared, the land would retain its fertility for centuries, and might, perhaps, be constantly improving. The effort to keep up the productiveness of land which is solely used for the cultivation of grain, by means of guano or artificial manures, is believed to be a vicious system of agriculture. That such manures are highly valuable in their way, and, in the hands of the judicious cultivator, will produce advantages which can hardly be over-estimated, is undoubtedly true; but, after all, with the exception of the alkalies and phosphates they contain, they do not possess the elements of permanent benefit. They should be regarded as in the nature of medicines, or like artificial stimulants on the human system. The true pabulum of the soil, provided and arranged by Nature for this very purpose, is obtained by the rearing of live stock, and in no other manner. Indeed, it is probably true that the use of other manures, followed by the continual cropping of the grain for market, will be found in the end only to render the soil more hopelessly bankrupt. It will galvanize it into spasmodic action for the occasion, but leave it afterwards more prostrate than before.

We shall be enabled to understand this truth more completely if we consider that, in order to obtain a healthful growth of any plant, several ingredients are necessary in the soil. When all the product is annually taken away, and nothing returned to the land, this regular and constant drain must, sooner or later, inevitably lead to exhaustion. But these indispensable ingredients are exhausted in different proportions; and when the soil becomes specially deficient in any one of their number, the application of any substance containing that ingredient in abundance will seem to work wonders. This is believed

to explain the reason why lime, gypsum, or guano produces such extraordinary results upon one soil, and so very little upon another.

But, notwithstanding the annual application of any one essential ingredient in which the soil was most deficient, if the constant robbery by grain-cropping be continued, the process of exhaustion still goes on with regard to the other ingredients, until some other essential element gives out, when an additional manure will be found necessary. The process may thus be continued until all the ingredients constituting fertility contained in the soil itself, become entirely exhausted, when it will be found altogether sterile.

If, instead of pursuing a course like this, the produce of the land were to be chiefly consumed upon its surface, the soil would never become impoverished. Even although a portion of the elements of fertility were annually abstracted from it in the shape of grain or other vegetable product sent to market, the deficiency would be supplied by the ingredients which plants and animals, and even the earth itself, derive from water, air, and other extraneous sources. The skillful and wise cultivator so graduates the growth and disposition of his products as not to draw from the soil what is not in some manner fully restored to it. No system of agriculture has been discovered for accomplishing this purpose effectually but the simple and natural one of rearing a large proportion of domestic animals, sufficient to consume most of the products of the farm upon its surface.

The inference properly deducible from these observations is, not that all manures except those which come from the barn-yard are objectionable, but that they are frequently misapplied; or rather that they have been too much depended upon. They should only be relied upon to cure some ascertained defect in the soil, or for special and temporary purposes; that is to say, until the recuperative power which Nature has provided can be fully and effectually applied. In other words, these manures should be chiefly employed on defective or worn out soils, to prepare the way for the cultivation of the grasses, the chief source from which domestic animals derive their sustenance, and therefore the most direct and effectual agency by which the land can be restored to, or preserved in, its normal condition.

It becomes a subject of prime importance, therefore, to ascertain what grasses are best adapted to different latitudes, soils, and situations, the relative amount of nutriment they respectively contain, and

various other facts falling chiefly within the province of the botanist and chemist.

In some portions of the country the grasses heretofore cultivated do not thrive, in consequence of heat and drought. Our western plains produce grasses which it is believed will, to a great extent, bid defiance to these causes of failure. In other regions, other difficulties prevent the successful cultivation of some of the grasses. May not these difficulties be ascertained, and the proper remedies applied, or, at least, other grasses substituted, which will not be affected by the same causes? These are some of the services which would be expected from a competent botanist, and which cannot be performed successfully by any one else.

In what has been proposed thus far, nothing but scientific investigation has been contemplated. It is certainly desirable that measures should be adopted of a more practical character. These are, in fact, always the most satisfactory. Science is like those senses which enable us to discover objects at a distance; but our knowledge of such objects is not complete until they are tangibly subjected to the examination of the other senses. The results are most satisfactory when all these methods of investigation are made to co-operate.

But how is such a mode of inquiry to be instituted? One method of doing this would be by the establishment of experimental farms in different sections of the country, where new products might be tested, and any other experiments made which should be deemed of sufficient importance. Such a course might be pursued under some governments, but would not be tolerated here. It involves too much machinery. Neither is it necessary, inasmuch as the results sought can be as fully attained by other means. Individual effort is mainly sufficient for this purpose, and, when such is the case, the government should not unnecessarily interfere. As in our political organizations, the arrangement which is deemed most judicious is found by placing the chief machinery in the States, and in the smaller and more distant localities, leaving at the centre the least amount of power and contrivance which are sufficient to secure the harmonious working of the whole system, so, in all our other institutions, the operation will be found most satisfactory when the same rule is observed—when nothing shall be undertaken by the federal government which can be as well and as effectually done by the States or by the people.

Now, there is no lack of interest and willingness for experimental effort manifested in all portions of the country on the subject of agricultural improvement. Most of our States and counties have their respective societies, all commendably engaged in promoting the success of this great leading national interest. There are also multitudes of amateur farmers scattered over the country, experimenting individually or in clubs, each of whom is ready and willing in any manner to contribute his share to promote any general plan of operations which might be deemed expedient. All that is necessary is, to introduce system and order into this great agricultural militia, in order to give it the efficiency.

One single, sensible, well-informed, experimental agriculturist might accomplish this entire result, by devoting his time and attention steadily and exclusively to the matter; by visiting different States, and conferring with those most interested in agricultural pursuits; making arrangements for trying various experiments in different sections of the country; alloting to each some specific matter, and advising as to the most judicious method in which all such experiments should be conducted; giving specific information as to the mode of planting various seeds, which, as at present managed, are not made to vegetate, because of the want of proper knowledge and skill in regard to their culture, and which, for various other reasons, are now subjected to unnecessary failure.

In this manner, all sections of the country might be made to act in concert, each contributing its proper share to produce one combined result, the magnitude of which would be almost incalculable, instead of being dissipated, as is too much the case, at present, in scattered, unsystematic, and comparatively fruitless efforts. An annual report of all thus attempted or accomplished would constitute a document of unusual interest and utility.

By this means, more might be effected than though the government were to undertake to manage and conduct, at its own expense, the whole series of experiments connected with the introduction and cultivation of new varieties of seeds, the rearing of new species or improved breeds of animals, the feeding out of various kinds of grasses or other food, and all other experiments which might be desirable for promoting the progress of agricultural knowledge in the country. The well-regulated, voluntary action of independent individuals is always more effectual than that resulting from the exercise of patron-

age or power by the government. This is the secret of the singular efficiency and success which are observed in the working of all the well-balanced institutions of a government like ours, which is founded on organized individual effort.

If, in the manner above proposed, too much is thought to be attempted, it is certainly done at small expense. Very little new machinery is contemplated. Existing organizations are mostly sought to be made use of, instead of creating new ones. All that is proposed is, the employment of three additional individuals who are to proceed quietly on their respective missions, at an annual expense of some six thousand dollars. It is doubtful whether any other investment could be made of the same amount of money which would yield so large and valuable a return. It certainly seems as though more useful and lasting results might be attained in this manner than if the same money were expended in the distribution of cuttings and seeds, and that the necessary amount might therefore be judiciously withdrawn from the latter object to be devoted to the former.

If it be objected that, in making all these appropriations for agricultural purposes, the government is departing from its proper sphere, and doing that for which it has no constitutional warrant, this is a question proper to be discussed and disposed of elsewhere than in this report. The province of the undersigned is, to carry out the wishes and follow the directions of Congress without questioning their propriety. This he has always endeavored to do, according to the best of his ability. The steps now suggested are not more objectionable, on this score, than others previously taken in agricultural matters. They are believed to be calculated to carry out the general design of Congress more thoroughly and successfully. If this general purpose is erroneous or improper, the responsibility rests not with the passive instrument by which it is effected.

It may not be improper to suggest, however, that not only would the objection we are contemplating prevent all appropriations for agricultural purposes, but the long-settled practice of the government, in many other respects, would be shaken by the establishment of a rule which should exclude the measures above proposed, as being beyond the legitimate action of the federal government. There is at least plausibility in the proposition, that as much authority can be found

in the Constitution for such an expenditure as for the establishment of a naval or military academy; that it is as lawful to promote the arts of peace as those of war; that the former are far more useful, and quite as germain to the general purposes for which the government was established, as the latter.

But, whatever may be thought of such a proposition, it may at least be asked with some confidence, how is it any more lawful to expend the millions that are annually devoted to the encouragement and security of commerce than to make direct appropriations from the treasury for the benefit of agriculture The latter is quite as much the basis of national prosperity and greatness as the former. And yet, rivers and harbors are improved, light-houses built, and vast expenditures incurred for the creation and equipment of a navy—all having for their main purpose the protection and benefit of commerce. Our navigation laws, too, furnish an instance of the exercise of the power and favor of the government in a manner which it seems difficult to reconcile with the notions of those who deny all power in the federal government to foster and encourage any particular branch of individual industry or enterprise.

If it is said that all these matters are more peculiarly of national importance, and that they require something more for their success than individual effort and energy, at least, this does not apply to the protection and encouragement which has been extended to manufactures, and for which the country has been indirectly taxed to the amount of untold millions during the last half century.

It is true that Congress has the power to lay and collect taxes, and must necessarily be clothed with a large discretion, as well in relation to the subjects as to the rate of taxation; but certainly, they cannot regulate the duties on imports with a direct view to aid the manufacturing interests, unless it is lawful to exercise the power of the government for that purpose; that is to say, unless they possess the constitutional right to legislate for the encouragement of the manufacturing interests of the country. If this is not legitimate and proper, where is the power, in laying duties, to discriminate, in the least, for any other purpose than with an eye single to the raising of revenue?

When was a tariff of duties ever framed upon this principle? When has one ever been adopted which did not intentionally cause

the people to pay their money for the very purpose of promoting the interests of the manufacturer? If the Constitution furnish no warrant for effecting this object directly, every law of this kind is a fraud upon that instrument. As well may it be violated openly as indirectly.

It has not been intended, in the foregoing remarks, to question the legitimacy of this well-established national policy, but only to show the difficulties of perceiving upon what principle all this favor can be extended to other pursuits, while the same encouragement should be hesitatingly and doubtingly yielded to the leading interest of the country—that interest, in fact, upon which all the others depend for their support, and which contributes at least its full share to the wealth, prosperity, and even the glory of the nation.

In fine, it seems manifestly just and proper that commerce, manufactures, and agriculture—the three great branches of national industry and wealth—should be regarded with equal favor by Congress. Whether, under our system of government, these should all be left to rely upon their own unaided energies, it is not proper for the undersigned to decide; but, from the position in which he finds himself placed, he feels justified in presenting the subject as it appears to the large portion of his fellow citizens who are specially interested in agricultural pursuits. Without intermeddling with questions of public policy, they may fairly regard themselves as justly entitled to share in the common benefits of the government to the burdens of which they contribute so largely. They look not for any special favor, but have a right to expect equality. If it be deemed expedient to adopt the policy of throwing private enterprise and industry entirely upon their own resources, unaided by government, except so far as to be protected from plunder, and untaxed, save for the sole purpose of providing the necessary revenue, they will be satisfied; but while, at the common expense, the favor of the government is almost lavished upon the other great branches of industry, they expect something for themselves. This expectation is so reasonable, that the favorable consideration of Congress is confidently invoked.

All which is respectfully submitted.

CHARLES MASON.

ANIMALS.

ON THE NUTRITION AND ECONOMY OF DIGESTION OF DOMESTIC ANIMALS.

BY D. J. BROWNE.

One of the most interesting occupations which the wide field of zoology offers to the physiologist is the investigation of the remarkable adaptation of organs to functions, and of these again to the necessities and well-being of the entire animal. Nor does it in the least diminish our interest in the investigation of individual adaptations, or our admiration on becoming acquainted with them, that we know *a priori* this universal truth, that all the constituents of every organized body, be that organization what it may, are invariably adapted, in the most perfect manner, to each other and to the whole. No scientific investigation, in which the animal physiologist engages, is more intimately connected with the success and practice of farming than the inquiry into the processes of nutrition. On the views we entertain with regard to its theory not only depends our success in breeding and rearing stock, and fattening animals, but also the economic management and consumption of our crops, as well as the application of manures. The greatest interest and the highest practical importance, therefore, belong to this beautiful branch of husbandry.

It is by a knowledge of the exact harmony in the animal economy that the comparative anatomist can determine, with almost unerring precision, the genus, or even the species, of an animal, by an examination of any important part of its organization, as the teeth, stomach, bones, or extremities. In some cases, a single bone, or even the fragment of a bone, is sufficient to convey an idea of the entire individual to which it belonged. In illustration of this, if the viscera of an animal are so organized as only to be fitted for the digestion of recent flesh, we find that the jaws are so constructed as to fit them for devouring prey; the claws for seizing and tearing it to pieces; the teeth for cutting and dividing its flesh; the entire system of the limbs or organs of motion for pursuing and overtaking

it; and the organs of sense for discovering it at a distance. Moreover, the brain of the animal is also endowed with instincts sufficient for concealing itself, and for laying plans to capture its necessary prey.

Again, we are well aware that the hoofed animals must necessarily be herbivorous, or vegetable feeders, because they are not possessed of the ordinary means of seizing prey. It is also evident that they have no occasion for a shoulder so vigorously organized as that of carnivorous animals, as they have no other use for their fore-legs than to support their bodies. Their food, being entirely herbaceous, only requires teeth with flat surfaces, suitable for brusing the seeds and plants on which they feed. For this purpose, also, these surfaces require to be unequal, and are consequently composed of alternate perpendicular layers of enamel and softer bone. Teeth of this structure necessarily require horizontal motions to enable them to triturate, or grind down, their herbaceous food.

The mouth of herbivorous animals is always capacious, so as to contain a large quantity of food. In the horse, the ox, and the sheep, it is lined with a strong, dense membrane, possessing but little feeling, and much less vascularity and sensibility than the red membrane which lines the mouth of carnivorous animals. That of the horse is distinguished by its great length, which admits of the development of the large molar teeth, and also of a space of some extent between the molar and incisor teeth, which affords a resting-place for the bit. This animal has the power of opening the mouth only to a small degree—far less so, indeed, than the ox; which, from the greater looseness of the cheek and the lesser length of the mouth, can open it wider, and can take in a much larger quantity of food at a time. In the sheep, there is less capability of extending the jaws than in the ox. In each of these animals, the lips greatly assist in collecting its food, and are largely furnished with the nerves of feeling, being composed of skin, muscle, and membrane, and possessing the power of motion and sensation in a high degree, for

"Sense, sure, they have, else they would not have motion."

In the upper jaw of the ox tribe, there are no incisors, but, instead thereof, a fibrous and elastic pad, or cushion. The design of this pad, which stands in the place of upper incisor teeth, and the part it takes in the procuring of food, may be thus described: The grass is collected and rolled together by means of the long and movable tongue; it is firmly held between the cutting teeth in the lower jaw and this pad, the cartilaginous upper lip assisting in the operation; and then, by a certain twitching motion of the head, the little roll of herbage is either torn or cut off, or partly torn and cut. The intention of this singular method of gathering the food, it is somewhat difficult satisfactorily to explain. It is peculiar to ruminants, which have one large stomach in which the food is kept, as a kind of reservoir, until it is ready for the action of the other three stomachs. While it is kept there, it is in a state of maceration, being exposed to the united influence of moisture and warmth; and the consequence

of this is, that a species of decomposition sometimes commences, and a vast deal of gas is evolved. That this should not take place in a natural process of retention and maceration, Nature possibly established this mechanism for the first gathering of the food.

The mouth is abundantly supplied with a watery fluid, called *saliva*, particularly during mastication, when it is secreted in considerable quantities. The action of this fluid is not certainly known; it contains a ferment (ptyaline) capable of changing starch and sugar, and rendering the solid proteine substances of the food soluble. Its chief use, however, it is believed, is to impregnate and moisten the food, thereby rendering it more easy of deglutition.

The mouth of herbivorous animals is principally filled with the tongue, which is muscular in its structure and very flexible, being, indeed, a principal agent in mastication and swallowing. It possesses both the power of feeling and tasting. The cavity of the mouth is separated from that of the nostrils by the soft palate—a muscular membranous substance fastened to the semi-circular border of the palate-bones, and hanging down on the back of the tongue, so that, in the ordinary state, there is no open communication between the mouth and the throat; and thus all breathing is carried on by the nostrils, and fluids, coming either from the lungs or the stomach, pass into the nostrils. When, however, food is passing to the stomach, it raises this membrane and then enters the *pharynx*, or food-bag, the membrane immediately afterwards falling down into its former position. The pharynx is a muscular cavity, situated at the root of the tongue, which receives the food from the mouth, and by its muscular power forces it into the gullet, (esophagus,) and thence into the stomach.

The abdomen of each of the quadrupeds under consideration is of large size, compared with that of man, or with carnivorous animals. The great volume of the large intestines in the horse, and the stomachs in cattle and sheep, demands a considerable space for their safe abode; the abdomen in the latter animals, however, is more capacious than in the former—an animal of speed and subsisting on more concentrated food. There is a remarkable difference in the construction and economy of the digestive organs in the horse and the ox. The former has a small stomach, usually holding about 3 gallons, and immensly large intestines; while, in the latter, the large intestines are scarcely more capacious than the small; but there are no less than four stomachs, the first of which is of considerable capacity, and will hold in an adult animal from 15 to 18 gallons. The alimentary canal in a full-grown ox would measure 60 yards in length, while that of the horse would not much exceed half that length. This difference shows—what, indeed, the habits of these animals also demonstrate—that, while on the one hand, th ox is organized so as to consume a very large quantity of food at meal, the horse, on the other hand, is adapted to consume a moderate quantity and often. If such a mass of food as is frequently found in the maw of the ox were contained in the stomach of the horse, it would be impossible for this animal to perform those severe

exertions which are frequently exacted from him; for the loaded stomach, pressing against the diaphragm—the muscle of respiration—would materially interfere with its action. It is a well-known fact in animal economy that, in proportion to the exertion is the expenditure of the muscular system and the consequent necessity for an equivalent supply of nutriment. If, therefore, bearing this in mind, we consider the smallness of the stomach, it seems evident that the horse was intended by Nature to consume concentrated food, such as grain, and the formation of the molar teeth strongly corroborates this view of the matter. These molar teeth, or grinders, as they are commonly and very expressively termed, are broader and less cutting than those of the ox, but decidedly better adapted for grinding corn as in a mill; for the teeth of the upper and lower jaw do not exactly correspond; but those of the latter are narrower, as well as the jaw itself, so that the lower jaw is moved from side to side, and the grain is thus triturated and ground as between two mill-stones.

In no other part of their bodies is there such a difference of structure as that which we find in the digestive organs of the ox and the horse. In the former, we have certainly the most elaborate mechanism for converting crude and indigestible substances into the element of flesh; and it is undoubtedly the fact, that the ox is capable of extracting more nutriment from a given amount of food than his equine rival. The horse, on the other hand, is more capable of performing exertion after a full stomach; and he can retain health with greater irregularity as to feeding than most other animals. The process of mastication is completed in one act; the food in both animals is conveyed by a long muscular tube, called the *esophagus*, through the cavity of the chest to the stomach. This tube, in the ox, is thicker than in the horse; and, towards its lower part, is furnished with muscles for the accomplishment of the process of rumination. Just as it enters the stomach of the horse it makes an acute angle, by which means vomiting is almost entirely forbidden.

The stomach of a horse is a strong muscular cavity, capable of considerable distention. It has been found that, in horses which have died of "stomach staggers," it sometimes stretches to an enormous extent. An instance is recorded in which this organ contained, with the hardened undigested food, a weight of upwards of 60 pounds. In other cases, it is distended with air to a considerable extent in flatulent colic or indigestion; but in the healthy state, it is comparatively small and of great strength. In the young calf, and also in the lamb, we find the fourth stomach considerably the largest, being fully developed, while the other three are but imperfectly so. This arises from the fact of the nutriment on which the young animal subsists—its mother's milk—being in so matured a state as to require comparatively but little exertion for the digestive organs; the other stomachs are therefore not required until the calf or lamb begins to crop the crude herbage, when the digestive apparatus gradually becomes developed. When the calf commences to feed upon solid food, it begins to ruminate, or chew its cud; and, as the quan-

tity of solid food is increased, so does the size of its first stomach increase, until it attains its whole dimensions. In the latter case, the first stomach has become considerably larger than the other three, taken together.

The stomach of the pig is very simple, much resembling that of man.

Reverting now to the other subject under notice, we find that, in the ox, the sheep, and other ruminants, the structure of the digestive organs is very different from that of other animals, and more complicated. They have a more difficult task to perform, namely, the elaboration of nutriment from cruder materials. The horse, it has been observed, in a state of nature, is almost constantly feeding, and when domesticated still requires food frequently. The ox and the sheep, on the other hand, take large quantities of food in a coarse state, and afterwards lie down, and submit it to the process of *rumination.* In this process, the food is turned and shifted about in the stomach by its muscular action, and well mixed with the fluid, secreted by the internal surface, it enters at first the superior compartment, from which it passes to the inferior, and again enters the former division, before rumination takes place. A rather full stomach is necessary for the act, as it has been found in sheep, which had fasted for several days, that a considerable portion of food still remained in the first stomach. In what manner the food passes through the curious arrangement of cavities in the stomachs of ruminants is a problem which has engaged the attention of naturalists from a very early period, a host of whom might be cited, who have failed to solve it. The French physiologist, M. Flourens, has done more than any or all of his predecessors to give clearness and precision to this intricate subject. The following is an abstract of the most important of his experiments:—

A sheep, having been fed on fresh clover, was killed and opened immediately; that is, before the process of rumination had commenced. M. Flourens found the greater part of this plant easily recognized by its leaves, which were still almost entire in the first stomach; but he also found a certain portion of those leaves, in the same unmasticated state, in the second stomach. In the other two stomachs, there was absolutely none. He repeated this experiment a great many times with plants of various kinds, and the result was constantly the same; from which it appears that herbaceous food, on its first deglutition, enters into the second stomach, as well as into the first; the proportion, however, being considerably greater into the first than into the second. It appears equally certain that, in the first swallowing, this kind of food only enters into the first two cavities, and never passes into the third nor fourth.

Having ascertained the above-named fact with respect to herbaceous plants, M. Flourens instituted a series of similar experiments in which the animals were fed upon various kinds of grain—rye, barley, wheat, oats, &c. The animals were killed and examined, as in the former experiments, immediately after being fed. He found the greater part of the grain unmasticated in the first stomach; but, as

in the case of the herbaceous plants, he also found a certain portion in the same unmasticated state in the second stomach. Neither the third nor the fourth stomach contained a single grain. He repeated these experiments many times, and always with the same result. He then tried the effect of carrots, cut into pieces from half an inch to an inch in length; and, in order that the animals might not chew them, he passed them into the pharynx by means of a tube. In one of these sheep, he found all the morsels in the first stomach, but in the other two, some of them were in the second stomach, and some in the first. In no case was there any in the third nor in the fourth stomach.

M. Flourens then proceeded to ascertain the effect of substances previously comminuted. He caused a certain quantity of carrots to be reduced to a kind of mash, with which he fed two sheep, and opened them immediately afterwards. He found the greatest part of this mash in the first and second stomachs; but he likewise found a portion in the third and fourth.

It is the opinion of the generality of physiologists that plain fluids pass immediately and entirely through the gastro-duct into the third and fourth cavities; but, according to the experiments of M. Flourens, this is not the case. He found, by making artificial openings into the stomachs of various sheep, that, as the animals drank, the fluid came directly out at the orifice in whatever cavity it might have been made. It is clear, then, that fluids pass in part into the first and second stomachs, and in part into the third and fourth; and they pass as directly into the former as into the latter.

The chief utility of rumination is applicable to all the animals in which it takes place, and the final purpose of this wonderfully complicated function in the animal economy is still imperfectly known. What has been already suggested on this point is quite unsatisfactory. Perrault and others supposed that it contributed to the security of those animals which are at once voracious and timid, by showing the necessity of their remaining long employed in grazing in an open pasture; but the Indian buffalo ruminates, although it does not fly even from the lion; and the wild goat dwells on Alpine heights, which are inaccessible to the beasts of prey. Whatever may be our ignorance of the cause of the object of rumination, it is certain that the nature of the food has a considerable influence in increasing or diminishing the necessity for the performance of that function. Thus, dry food requires to be entirely subjected to a second mastication before it can enter the third and fourth stomachs; while a great portion of that which is moist and succulent passes readily into those cavities on its first descent into the stomach.

In reverting to the process of digestion, in herbivorous quadrupeds, we are struck with the wide difference that is found in their digestive organs. They are extensive and complicated, having a far more difficult and elaborate office to perform than those of carnivorous animals. The food of the latter is taken, as it were, ready prepared; its constituents closely resemble those of the blood itself, and, of course, it is exactly similar to the flesh it is intended to

nourish. A smaller quantity of food only is required to be taken, and nearly the whole of this food is employed in nourishing the system or supplying its waste. The digestive organs of herbivorous animals, however, have a much more onerous task to accomplish; the food is in a more crude or less prepared state; the nutritious portions bear a much smaller ratio to the whole mass, and, accordingly, that taken is of very considerable bulk. To meet these peculiarities, the digestive organs are much more spacious and more complicated than those of the carnivora; means are afforded for detaining the food until the nutriment can be properly extracted, a larger amount of chemical and vital force is employed, and a more abundant supply of nervous energy afforded. The horse, for instance, in a state of nature, is almost continuously feeding; he bites short and well triturates his food, but is almost constantly so engaged; and though, in a domesticated state, the food is not so abundant nor so frequently taken, it is in a much more nutritious form. Corresponding to these natural habits, we find that, though the alimentary canal altogether is of an enormous bulk, the stomach itself is single and of moderate size. Digestion is almost constantly going on; chyme is passing out of one orifice of the stomach as food is coming in at the other, and the supply of bile, there being no reservoir for it—no gall-bladder, as is the case with man and most other animals, for the reception of it. The smallness of the stomach is compensated for by the prodigious bulk of the large intestines. Thus, the horse, without requiring a large quantity of food, is yet able to perform great physical exertions, and can make them after a full meal more readily than any other animal.

The ox, the sheep, and other ruminating animals, like the horse, have very extensive digestive organs, very differently arranged. The horse, in a state of nature, will rarely get fat; the ox and the sheep, in good pasture, will almost invariably do so, and will otherwise greatly increase in size; their digestive organs are, therefore, more bulky than in the horse, and much more complicated. The intestines are of greater length, though not so large, and, instead of one stomach, there are four.

As before observed, man and most animals possess a gall-bladder for the reception of, and as a reservoir for, the bile; but the horse does not possess any, so that the bile is almost continually being poured into the bowels. The reason of this peculiarity is, that the horse in a state of nature is continually feeding; having a small stomach, it requires frequent replenishing, and consequently there is a continued demand for bile. The ox as well as the sheep, on the other hand, fills the first stomach and then ceases to eat for some time; consequently, he requires a large supply of bile at particular periods, as this is afforded by means of a reservoir—the gall-bladder. The internal structure of the stomach of the horse is somewhat curious, one half being lined by an insensible coat of a white color, while the other half is red, and possesses sensibility,

and secretes the peculiar fluid called the *gastric juice*.* The former portion of the stomach first receives the food, which is afterwards passed to the other part, where the first process of the digestion takes place.

During the period of digestion, three processes are going on continually, and side by side, in the body of the animal—the process of respiration and generation of heat; the process of renewal and assimilation; and the process of rejection. All three are sustained by the blood which permeates all parts of the system. The digestion of the food, as we have seen, begins at the mouth of the animal, where it becomes mixed with saliva; it continues in the stomach and intestinal canal, and ceases when all the soluble substance of the chyle has passed into the blood for the purpose of nutriment.

But, in the economy of digestion, a knowledge of the composition of the various articles of food, and of the ultimate products resulting from a series of internal changes during the process of nutrition, together with that of the scientific principles established by the conjoined labors of physiologists and chemists, is fortunately of more immediate interest and greater importance to the practical man than an acquaintance with all the minute and complicated changes which take place in the interior of the animal. In many instances, such a knowledge will enable the intelligent farmer to apply food with the greatest advantage, and to determine its proper selection for the different species of animals and for the purposes for which they are kept. Experience teaches that the different varieties of domesticated animals live best on mixed food, and that fattening stock require a different food from young animals. Generally, the practical directions given by feeders agree well with the dictates of science, but sometimes they cannot be carried out without incurring a great waste of feeding materials. It would be out of place, however, within the limited length allotted to this essay, to discuss systematically the more refined inquiries into the internal changes accompanying the processes of nutrition, or to criticise the various theories to which these inquiries have led.

* It is found by chemical experiments that the gastric juice has very peculiar properties. Though it is for the most part a tasteless, clear, and seemingly a very simple liquid, it nevertheless possesses extraordinary powers of dissolving substances with which it touches or mixes, and it varies in different classes of animals. In one particular, it is the same in all animals—it will not attack living matter, but only dead—the consequence of which is, that its powers of eating away and dissolving are perfectly safe to the animals themselves, in the stomachs of which it remains without ever hurting them. This juice varies in different animals according to the food on which they subsist. Thus, in birds of prey, as kites, hawks, owls, &c., it only acts upon animal matter, and does not dissolve vegetables. In other birds and in all animals feeding on plants, as oxen, sheep, hares, and the like, it dissolves vegetable matter, as grass, but will not act upon flesh of any kind. It may further be observed, that there is a most curious and beautiful correspondence between this juice in the stomach of different animals and the other parts of their bodies connected with the important operations of eating and digesting their food. The use of this juice is plainly to convert what they eat into a fluid, from which, by various other processes, all their parts, blood, bones, muscles, &c., are afterwards formed.

THE HORSE.

ORIGIN, HISTORY, AND HABITS.

The reduction of the horse to a domesticated state is the greatest acquisition from the animal world ever made by the art and industry of man. The history of this noble quadruped, as regards his origin, or natural locality, and the period of his first subjugation, is involved in obscurity. We learn from the Sacred Writings that he is of Eastern origin; and they render the inference very probable, that the Egyptians were the first who reduced him to servitude.

The earliest notice of the horse occurs about 650 years after the Deluge, when the Egyptians "brought their cattle to Joseph, who gave them bread in exchange for horses and for the flocks," &c. Very soon after, we read, the venerable patriarch, Jacob, when dying in Egypt, addressing his sons, said: "Dan shall be a serpent by the way, an adder in the path, that biteth the horse's heels, so that his rider shall fall backward;" and it is remarkable that this early allusion to the horse refers to him as being ridden, and not as drawing a chariot. When the body of Jacob was removed by his son Joseph from Egypt to Canaan, for burial, we are told that, "there went up with him both chariots and horsemen." As it appears, then, from this notice, as well as from the employment of numerous chariots by Pharaoh in pursuit of the Israelites, and from the testimony of the earliest profane writers, that the Egyptians first reduced the horse to obedience, it is to their country, or, at least to those parts of Africa which were in close connexion with it, that we may reasonably look for his primitive habitat. The long-admitted superiority of the horses of Arabia is no evidence that they were originally placed in that arid country; and there is much reason to conclude that it was not until a comparatively late period that the Arabs used horses. At the time when Solomon was receiving various treasures from Arabia, it was from Egypt only that he obtained his immense number of horses. Herodotus expressly states that Xerxes obtained a portion of his cavalry from Ethiopia, and that he was joined by a body of native Indians, some on horseback and others in war-chariots.

The primitive habits, contour, and color of the horse, in a purely natural condition, cannot be said to be known with certainty; for it is highly probable that he has long ceased to exist in such a state. As the wild horses which are now found in various parts of the world appear to have sprung from a domesticated stock, they afford no clue to the elucidation of the points in question. The numerous herds of wild horses existing on the plains of Tartary do not appear to have been indigenous to that country, and the still greater numbers which inhabit South America are very clearly traced to the

horses which the Spaniards introduced into that part of our continent from Europe; and old writers tell us that, when the American Indians first saw a man on horseback, they thought the man and the horse to be one and the same individual, a kind of Centaur, growing

> "——unto his seat,
> As he had been incorps'd and demi-natur'd
> With the brave beast."

To describe the horse as we find him at present, it may be said that he is distinguished from all other solid-hoofed animals of his order by the possession of callous, wartlike protuberances on the hind, as well as on the fore-legs, and of a flowing tail, and by the absence of a dark stripe along the back; although it is stated, on the authority of Macdonald, in a paper read before the Royal Society of England, in 1839, that, in Scotland, there is a race of horses called the "Eel-back Dun," and that many of this breed have the back and legs marked like those of the zebra. Walker, however, in his "History of the Hebrides," merely says, that the horses of the Scottish Highlands and of Norway have a mark resembling an eel, extending from the shoulder along the right of the back, to the rump. Everybody knows that horses vary greatly, not only in size and color, but in shape; the principal breeds even exhibiting sensible differences in the form of the head, and their bodies and limbs being variously proportioned, in adaption for the uses to which each breed is more especially applied.

Most singular physical modifications take place in the horse, from change of food, climate, and exposure, as instanced at page 1, in the Agricultural Report of the Patent Office for 1855. If allowed to lie out in the open air, during the winter of a cold climate, he acquires a long shaggy coat; but, if kept in a warm stable, and particularly if clothed, he retains his usual short and sleek summer coat. Sensible differences are also observable from the effects of castration. On the authority of a veterinary surgeon of the British Army, who practised ten years in India, it appears that the hair of the horse, when emasculated in cold weather, ever after is rough, and changes from a stiff, uniform calibre to one that is irregular and fine. It also increases in numbers as well as in length. The hoofs afterwards, he says, become more solid and firm.

The horse breathes through his nostrils only, and not through the mouth; for, in the severest exercises, the mouth is never seen open, unless the lower jaw be violently pulled down by force of the bit. This accounts for the great dilatation of the nostrils during and after running. When feeding on natural herbage, he grasps the blades with his lips, by which they are conducted between the incisor or front teeth. These he employs for the double purpose of holding and detaching the grass, the latter action being assisted by a twitch of the head. The ox, on the contrary, uses the tongue to collect his food; that organ being so directed as to encircle a small tuft of grass, which is placed by it between the incisors and an

elastic pad opposite to them in the upper jaw; between these the herbage is pressed and partly cut; its complete severance being effected by tearing. The sheep gathers its food in a similar manner as the horse, and is enabled to bring its cutting teeth much nearer to the roots of the plants, in consequence of the upper lip being partially cleft, which is susceptible of considerable mobility; while that of the ox is thick, hairless, and of very limited action.

When prostrate on the ground, in getting up, the horse rises first on his fore-legs, and completes the operation by elevating his hinder parts. The ox, on the other hand, rises first on his hind-legs, then remains a short time upon his knees, until his hind-legs are straightened, immediately after acquiring a standing position.

In the wild state, the horse has no intermediate pace between the walk and the gallop. It is a common but erroneous notion, that the domesticated horse, when walking or running, lifts simultaneously the right fore-leg and the left hind one, or *vice versâ;* and hence, in some equestrian statues, we see two diametrically opposite legs suspended from the pedestal. It is a difficult thing, however, to keep the eye upon four legs at once, but, nevertheless, if a horse be long and carefully observed, when he is going at a slow pace, it will be seen that, if one foot is raised from the ground, the other three are on the ground, though all are preparing to leave it in their turn; and it will be evident that this process is adopted in his quicker ordinary motions. In some movements, the two fore-legs are raised together, while the two hind ones are on the ground, and the latter are raised together when the former are put down, and so on successively; and, in "cantering," both pair of legs are often raised from the ground at each strike the animal gives to the surface.

The horse's movements are not confined entirely to the earth. He takes to the water naturally, and can swim far and in graceful style, even in the sea,

> "And eke the courser, whereupon he rad,
> Could swim like to a fish whiles he his back bestrad."

Horses differ in intelligence, disposition, and temper. Those who profess to know anything about them pay much attention to the size, position, and motion of the ears. Horses with rather small than large ears, placed not too far apart, erect and quick in motion, indicate both breeding and spirit; and if a horse is in the frequent habit of carrying one ear forward and the other backward, especially if he does so on a journey, he will generally possess both spirit and endurance. The stretching of the ears in contrary directions shows that he is attentive to everything that is passing around him; and, while he is doing this, he cannot be much fatigued, nor likely soon to become so. It has been remarked that few horses sleep without pointing one ear forward and the other backward, in order that they may receive notice of the approach of objects in any direction. Dr. Arnott says that, "when horses or mules march in company at night, those in front direct their ears forward; those in the rear

direct them backward; and those in the centre turn them laterally, or across; the whole troop being actuated by one feeling, which watches the general safety." The temper is more surely indicated by a motion of the ear than of the eye; and an experienced observer of horses can tell by the motion of their ears all that they think and mean. When the horse lays his ears flat back upon his neck, and keeps them so, he is most assuredly meditating mischief, and the bystander should beware of his heels or his teeth. In play, the ears will likewise be laid back, but not so decidedly, nor so long; a quick change in their position, together with the expression of the eye at the time, will distinguish between playfulness and vice. The hearing of the horse is remarkably acute; a thousand vibrations of the air, too slight to make any impression on the human ear, are readily perceived by him. It is well known to sportsmen that a cry of hounds will be recognized by the horse, and his ears will be erect, and he will be all spirit and impatience, a considerable time before the rider is conscious of the least sound. The eye of the horse is also a pretty accurate index of his temper; and experience has shown that, if much of the white of the eye is seen, he is a dangerous one, ever slyly watching for opportunities to do mischief; and the frequent backward direction of the eye, when the white is most perceptible, is only to give sure effect to the blow which he is about to aim.

Like the dog, the horse often becomes indissolubly attached to the habits and manners to which he has long been accustomed. He delights in the noise and tumult of arms, and faces the enemy with alacrity and resolution. Equally intrepid as his master, he encounters danger and death with ardor and magnanimity. But it is not in perils and conflicts alone that he willingly co-operates with his rider; he likewise participates in human pleasures. He excels in the tournament and in the chase; his eyes sparkle with emulation in the race-course. But, though bold and intrepid, he suffers himself not to be carried off by a furious ardor; he represses his movements, and knows how to govern and how to check the natural vivacity and fire of his temper. He not only yields to the hand, but seems to consult the inclination of his rider. Uniformly obedient to the impressions he receives, he flies or stops, and regulates his motions entirely, by his master's will. In a measure, he renounces his very existence to the pleasures of man. He delivers up his whole powers; he reserves nothing, and often dies rather than disobey.

These are features in the character of the horse, the natural qualities of which have been perfected by art, and trained with care to the service of man. His education commences with the loss of liberty, and is completed by restraint. When employed in labor, he is always confined within the harness; and, even during the time destined for repose, he is not always delivered from his bonds. If permitted sometimes to roam in the pasture, he still bears the marks of servitude, and often the external impressions of labor and pain. His mouth is deformed by the constant friction of the bit; his

sides are galled with wounds or furrowed with scars, and his hoofs are pierced with nails. The natural gestures of his body are often constrained by the habitual pressure of fetters from which it would be in vain to deliver him; for he would not be more at liberty.

With this servile picture let us compare those wild horses which have multiplied so prodigiously in South America, and live in perfect freedom. Their motions are neither constrained nor measured. Proud of their independence, they fly from the presence of man, and disdain all proffered care. They search for and procure the food which is most salutary and agreeable. They wander and frisk about the immense prairies, and crop the fresh productions of a perpetual spring. Without any fixed habitation, or other sheltei than an open sky, they breathe a purer air than those animals confined in musty vaults, when subject to the dominion of man. Hence, wild horses are stronger, more nimble and nervous than most of those which are in a domesticated state. They possess force and dignity, which are the gifts of Nature; they are by no means ferocious in temper, but are only fiery and wild. Though of strength superior to most animals, they never make an attack; but when assaulted, they either disdain the enemy, bound out of his way, or perhaps strike him dead with their heels. They associate in troops, acquiring a mutual attachment for each other, from no other motives than the pleasure of being together; for they have no fear As vegetables constitute their food, and as they are not carnivorous, they neither make war with other animals nor among themselves. They dispute not about the common right of food, and never have occasion to snatch from each other any prey—the general source of quarrels and combats among the rapacious tribes; hence they live in perpetual peace. All these features are apparent in young horses bred together in troops. Their manners are gentle and their temper social; their force and ardor being generally rendered conspicuous by marks of emulation. They anxiously press to be foremost in the course to brave danger, in traversing a river, or in leaping a precipice or ditch; and it has been remarked that those which are most adventurous and expert in these natural exercises are the most generous, mild and tractable when reduced to a domesticated state. They appear to be under the command of a leader, the strongest and boldest of the herd, and which they implicitly obey. A secret instinct teaches them that their safety consists in union and subordination. When attacked by a tiger, at some signal intelligible to them all, they either close into a dense mass, and trample their enemy to death, or place the mares and foals in the centre, forming themselves into a circle, and welcome him without with their heels. In the attack, their leader is the first to brave the danger, and, when prudence demands a retreat, they follow his rapid flight.

D. J. B.

ARDEN HORSES.

There formerly existed, in the region of the Ardennes of Belgium and France, a race of horses much vaunted for their solid qualities and power of endurance; but, from neglect, careless breeding, and incessant drafts for military purposes in the revolution of 1789, it has become so far degenerated, that it is no longer to be found in its original type; though it is still believed that, under the beneficent influence of soil, climate, nourishment, and a rational course of breeding and treatment, this race could be restored to its primitive character, full of enduring qualities and utility—propities so much desired for the general work of the farm, as well as for the present wants of the army of France.

The Arden horse, from its deep-spreading muscular breast, large, straight shoulders, and rounded, compact form—qualities requisite for strength and endurance—is not regarded as a handsome animal; but these properties are amply compensated for by its gentle disposition, robust habit, and power to resist great fatigue, as well as to withstand hard labor and indifferant fare. In fact, there is combined in this breed a little of everything to be found in the light cavalry horse down to one which is exclusively adapted to a comparitively slow draft. D. J. B.

SHEEP.

ORIGIN, HISTORY, AND HABITS.

Of all domestic animals, the sheep is that of which we find the earliest and most frequent notice in the Sacred Writings, as being intimately associated with some of the civil and relgous institutions. "Abel was a keeper of sheep." It was the custom to give names to sheep, so that when the shepard wished to remove the flock he called them by name, and they immediately obeyed. It would seem that in large flocks it was only a portion of them, probaly the leaders, which were so docile as to come at the call; and it was perhaps quite enough that a few should be so obedient, as the others would be sure to imitate the example. Christ, in reference to himself, as the Good Shepherd, says: "The sheep hear his voice, and he calleth his own sheep by name, and leadeth them out; and he goeth before them, and the sheep follow him; for they know his voice." This custom still prevails in Greece, and in many parts of the East.

As the sheep existed in the primordial era of man on the globe, we must look to Western Asia as its original habitat. From this centre, it has more or less gradually spread by human agency; and, influenced by climate, food, and treatment, it has ramified into numer-

ous variations, differing so widely from each other in external form and covering, that we know not which of them to regard as most characteristic, most indicative of the original type, from which our present races have descended. Naturalists have entertained themselves with conjectures as to a *wild* stock, whence the domestic sheep has sprung; some asserting the mufflon (*Ovis musmon*) of Barbary, Crete, Corsica, Sardinia, and the islands of the Grecian Archipelago to be its origin; others, the argali (*Ovis ammon*) of Siberia; while others again, consider it likely that more than one wild species have commingled to form the numerous domestic breeds. But when we consider that, for several thousand years, the sheep has been subject to the dominion of man, and undergone many modifications, we cannot help doubting as to the recognition of a primitive type; nay, it even may be doubted whether such a type can be found at present in any existing race. Whatever may have been the type of our common sheep, however, there can be no doubt that they are naturally mountainous animals. For, if left to themselves, it is always observed that they prefer hill-sides and rocky mountains to valleys and low plains; and, in the former situations, they thrive better, although they acquire less flesh than on more luxuriant soils.

The original color of the sheep was undoubtedly dark-brown, and the change from this shade to white must have been the work of skillful breeding and of time. Most writers on sheep impute, and perhaps justly, the first improvement in this respect to the skill of Jacob. However this may be, white flocks were seen at an early date, and in Western Europe have long been universal; still, however, as if to show that Nature, though controlled, is not to be subdued, we see lingering traces of the dark-brown in many of our breeds, this color prevailing about the face and on the legs; and now and then a black or dark-shaded lamb may be noticed in the midst of a snowy flock, indicating by its presence how easy would be the transition from the acquired but common color of our races to that of their primeval progenitors.

The sheep is pre-eminently a wool-bearing animal; yet many races seem to be destitute of this covering, particularly in tropical climates, and to be clothed with short hair—or, indeed, if it be essentially wool, it so closely resembles hair as not to be distinguishable from it unless by means of a powerful lens. The mufflons and argali, that is, the wild species, are covered with a harsh kind of hair, having beneath it, at its roots, a short, spiral wool, which, in winter, becomes longer and more full. Indeed, Mr. Bell, an English writer, considers the harsh hair as essentially wool in its structure, presenting the imbrications which the microscope shows to be the characteristic of wool, and on which its felting property depends; and he regards the short under-coat as composed of hair, and not of wool. Mr. Youatt makes the contrary statement, and, notwithstanding the appearances noticed by Mr Bell, one might be inclined to the opinion of the former; for, be it observed, in the Cashmere and Angora goats, the long outer covering is hair; the short under-coat exquisitely fine down, or wool. In other down or wool-bearing ani-

mals, as the beaver and otter, a similar arrangement prevails; and we know, moreover, that, in some neglected breeds of the domesticated sheep, the wool becomes mixed with long, coarse hairs, by which it is more or less obscured. The causes which have rendered the fleece of the common sheep what we now find it are involved in obscurity. In the first instance, much is attributed to the effects of the temperature; for, though the Merino of Spain, and the flocks of Australia, Southern Africa, and of America are pre-eminent as wool-bearers, yet it would seem that the disposition to develop wool at the expense of hair is acquired only in temperate, elevated or even cold climates. For instance, the wool of the Bhootan domesticated sheep, called "Huniah," is superb, and the animal is suited only to the northern districts of Napal, in India, suffering much from the heat of the central district. On the other hand, it is clear that, in the early ages of man's history, the shepherds must have selected for breeding those individuals on which the wool predominated, and that, by following up this system, the sheep gradually attained its present condition, so that the wool-bearing breed became at length permanently established. Originally, perhaps, the sheep, then a wool-bearer, and long domesticated, was of a brown or rusty-black color, a hue still lingering on the faces and limbs of many of our breeds, and sometimes appearing as the general tint of individuals, thus conspicuous in the midst of their white-fleeced companions. Nine out of ten of the sheep of Deccan are black, with short, crisp, coarse wool.

To revert again to the question as to the origin of the domestic sheep, it is clear that we cannot identify it with any wild species with which we are yet acquainted. If such exist, it is most probably to be found in the mountains of Armenia; but this is problematical; and there is some ground for supposing that, though the sheep of every region intermingle with each other, they have descended from different primitive stocks. The subject is full of obscurity. It is, indeed, strange that, while history teems with the accounts of battles, massacres, invasions, the reigns and the crimes of kings, it throws no light upon our domestic animals. The subject was too mean for history—the actors too humble to be noticed; but thus it ever is that the glare of crimes and mighty deeds effaces the record of the useful, the beneficent, and the truly great. Meanwhile, I am inclined to concur with those who are of opinion that the sheep, in common with other domesticated animals, has been the companion and servant of man since the day when "Adam gave names to all cattle, and to every fowl of the air, and to every beast of the field."

There are few animals which form so steady and permanent an affection for each other as sheep; and the acuteness and willingness with which they are easily taught to obey the call or the whistle of the gentle shepherd in mountains or wild countries over which the flocks wander dispersedly, is manifest from the manner in which they answer to the signal notes of the horn or the pipe. In many parts of the Alps, and in certain provinces of France, the shepherd and his sweet music continue with true antique simplicity. He

returns homeward at sunset, with his sheep following him, and seemingly pleased with the sound of his instrument, which is blown with the reed, and resembles the chanter of a bag-pipe.

Both in its natural and domesticated state, the sheep is more or less a gregarious animal, collecting in flocks of greater or fewer numbers, according to the nature of the district it frequents, and the abundance of pasture. In a wild state, these flocks are generally small, composed of females and a few males. As the breeding season approaches, the contests between the latter for the sovereignty of the harem are fierce and obstinate; their enormous horns forming at all times powerful weapons, either for self-defence or mutual destruction. The more the sheep is neglected, and the less its range of pasture is circumscribed, the more will it acquire habits of independence, and the more will its instincts be drawn forth and put into exercise. In wild and mountainous districts, it has been remarked that sheep unite in self-defence, and form themselves into a phalanx in opposition to a strange dog, or a prowling fox, the rams heading the array, and presenting a formidable front to the foe, while the ewes and lambs crowd together in the rear. Should the intruder venture within a certain distance, they rush upon him and commence a violent assault. This and many other facts on record seem to justify the conclusion that this animal is not so utterly destitute of intelligence as is usually supposed. If the materials for the history of the sheep consisted solely of observations made on the habits of those which are kept as we see them in low and inclosed fields, one might perhaps concur in the opinion that it is a stupid, silly, timid and inactive animal; but the sheep of the mountains, having more of their real nature called into action by their comparative freedom and greater exposure, convey a very different and more correct notion of the disposition and habits of their species. On the mountains, they display considerable boldness and agility in leaping from crag to crag, and frequently climbing about the whole surface of the almost perpendicular sides of the precipitous rocks, by treading upon the narrow ledges and projections, which scarcely afford them room to stand. In these apparently dangerous situations, sometimes at a height of several hundred feet, and with the billows of the ocean roaring beneath them, they show that they are not such cowardly and stupid beings as they have been described. They exhibit great daring intrepidity, and a full confidence in their skill and adroitness, vieing with the goat in sureness of step and strength of spring, when they are ascending to the summit by repeated bounds. With regard to the courage of sheep may be instanced the boldness with which the ewe not unfrequently defends her offspring from danger, and the desperate combats often occurring between the rams, which seem to have an indelible feeling of mutual jealousy; for, as soon as they come together, they rush headlong at each other with immense force, the concussion of their heads being audible at a distance of many rods,

"Never was there anything *so sudden*, except the battle of two rams.—*Rosalind.*"

Reverting from these scenes of cruelty, a propensity common to many male animals on such occasions, let us remind the reader of the pleasing spectacle of a large flock of snow-white sheep, emblems of innocence, collected together on the sunny hill-side, or reposing beneath the shade of some lofty tree—a sure token of civilization, impressing the observer with the commercial importance of this animal, its connection with international relationships, political economy, and general prosperity. The whole picture is full of poetry and interest, and one must be alike destitute of patriotism and taste who can look upon it with indifference. D. J. B.

SOUTH DOWN SHEEP.

The range of chalky hills, called the "South Downs," and from whence the sheep in question derive their name, commences at the east end of the county of Sussex, in England, and extends westward from Lewes, Shoreham, and Arundel, by a continuous elevated chain inland, their length being upwards of 60 miles, with an average breadth of about 5 miles. Contiguous to this range of hills, is a tract of arable land, on both sides attached to the Down farms, and which affords the means of supply of artificial food for the sheep during winter and spring. The herbage of these hills is very short and fine, but well adapted to the keeping of sheep, large numbers of which have, from the earliest known period, occupied these pastures; and, while the natural healthiness of the climate, consequent upon the dryness of the air and moderate elevation of the land, is eminently favorable to rearing a race of "Down," or "Mountain" sheep, the arable land connected with these Downs affords the means of a supply of other food, when the natural produce of the latter fails; and it is owing to this combination of favorable circumstances that a larger number of sheep are kept on this tract, than on any other of similar fertility on the globe.

We have no authentic records of the early history of this breed of sheep, which, in its original state, was not superior to that of any other varieties inhabiting similar districts. As far back as our knowledge of them extends, both ewes and rams were destitute of horns; although it is probable that the elder race was horned, as are other breeds of mountain sheep. It is not unusual, in the present day, to see a male Down lamb with small horns. The original prevailing color of the wool was probably black; although, at present, comparatively few black sheep are seen among this breed; yet, only a few years ago, black or spotted lambs were much more common than they are now. A writer in Young's "Annals of Agriculture" (vol. xxii, p. 243) remarks that, "he is convinced that, were the South Down breed to be left in a wild state, they would in a few years become entirely black; for there are, every year, notwithstanding all the care that can be taken to prevent it, great numbers

of black and white lambs, some with large black spots, some half black, and some entirely black." Although this breed has been in a state of progressive improvement for more than 70 years, and great care has been taken in sorting the sheep, yet, even now, in the best managed flocks, a spotted or black lamb is occasionally seen.

The late Mr. John Ellman, of Glynde, near Lewes, was one of the earliest and most distinguished improvers of this breed. He did not, as was the case with his great contemporary, Bakewell, the founder of the "New Leicesters," endeavor, as it were, to create a breed, but took as a basis a selection from the best flocks of the "Sussex Downs." He first turned his efforts to the improvement of this sheep about the year 1780, and, during a residence of 50 years at Glynde, by the closest attention and continued perseverance in the well-known principles of breeding, brought his flock to a high state of perfection. And it ought to be recorded of him that he exhibited none of that selfishness which, it is to be regretted, characterized Mr. Bakewell's proceeding; but was so zealous in his endeavors to advance their improvement generally, that he was always ready to give every information in his power.

Mr. Ellman describes the South Downs, formerly, "as being of a small size and far from possessing a good shape; they were long and thin in the neck, high on the shoulders, low behind, high on the loins, down on the rumps, the tail set on very low, almost perpendicular from the hip-bones, sharp on the back, the ribs flat, not bowing, narrow in the fore-quarters, good in the leg, although having a large bone." They are also described as having a very light fleece, and were not considered to have arrived at maturity for fattening till they were three years old. Mr. Ellman's flock is thus described by Arthur Young, in 1794: "Mr. Ellman's flock of sheep, I must observe in this place, is unquestionably the first in the country; there is nothing that can be compared with it; the wool, the finest, and the carcass the best proportion; although I saw several of the noblest flocks afterwards, which I examined with a great degree of attention. Some few had very fine wool, which might be equal to his, but then, the carcass was ill-shaped, and many had a good carcass with coarse wool; but this incomparable farmer has eminently united both these circumstances to his flock, at Glynde. I affirm this with the greater degree of certainty, since the eye of prejudice has been at work in this county to disparage and call in question the quality of his flock, merely because he has raised the merit of it, by unremitted attention, above the rest of the neighboring farmers, and it now stands unrivaled."

The Duke of Richmond, Mr. Jonas Webb, and other contemporaries and successors of Mr. Ellman, have, with varied results, but continued progression, carried further the good work so well begun by him. These sheep, both for symmetry and constitution, as well as for early maturity, now rank on an equality with, if indeed they are not superior to, the best breeds in the kingdom. In shape and character, they have altered very much, being smaller in the bone, equally hardy, and with a greater disposition to fatten is combined

a heavier carcass when fat. All good breeders, who have devoted much attention to the subject of sheep-rearing, concur in the opinion that a well-proportioned animal is the best criterion of a good constitution and aptitude for fattening. A small head, though an indication of a well-bred sheep, is also accompanied by a want of size; the head should be of a medium length, and the lips thin. The under-jaw, or chap, should be fine and thin; the ears tolerably wide apart, well covered with wool, and not too thin. The forehead should be well covered with wool, especially between the ears, as it is a great protection against the fly; the eye full and bright, but not prominent. The neck should be of proportionate length, thin next the head, and enlarging towards the shoulders, where it should be broad and straight on the top, and not what is generally called "ewe-necked." The breast should be wide and deep, projecting well forward between the fore-legs. This is considered an essential point with graziers, as the breast gives the sheep a greater degree of weight, and also indicates a good constitution and disposition to thrive. The shoulders should be on a level with the back, and not too wide above. If the shoulder-plates are very wide on the top, it is generally found that the animal drops behind them. The back should be flat, from the shoulders to the setting on of the tail. The ribs should project horizontally from the spine, extending far backward, and the last rib projecting more than the others. The rump should be long and broad, the tail set on high, and nearly on a level with the spine; the hips wide, and the space between them and the last rib on either side, as narrow as possible, thus preventing the dropping of the belly; the ribs generally presenting a circular form. The legs should be of proportionate length; the hind-legs full in the inside at the point called the "twist;" the hock, or hough, rather turning out. The fore-legs should be straight from the breast to the foot, and not what is generally called "knock-kneed." The South Down sheep, in fact, is the model of what the hill sheep ought to be, and the flesh, in fineness of grain and flavor, is peculiarly excellent. The wool is of a very useful quality, but is both larger in fibre and less numerously serrated than the short Saxony, and does not, therefore, possess such a felting power; hence it is rarely used in the manufacture of fine broad-cloths. Still, from its fineness and felting properties, compared with the wool of many other middle-woolled breeds, it is highly esteemed; and for flannels and worsted goods, in general, is extensively employed.

Within the last 30 years, the "Improved South Downs" had been sent from England to Scotland, Ireland, Germany, France, Russia, Australia, Spain, Portugal, the West Indies, and the United States; and it is extraordinary that, in climates differing so widely, they bear equally well both heat and cold. In viewing them in our own country, whether it be on the bleak hill-sides of the North, in the fertile valleys and vast prairies of the West, on the sandy plains and rolling pastures of the South, they are alike flourishing and content; being unsurpassed in the quality of their mutton, and a facility of taking on fat with small consumption of food. Their

early maturity, quiet disposition, and endurance for long journeys, without the loss of flesh, also render them great favorites wherever they thrive. D. J. B.

ENGLISH AND SCOTCH DAIRY MANAGEMENT.

[Condensed from recent English Authorities.]

Dairy management, in its popular sense, refers to every department of agricultural industry and domestic economy which relates to the treatment of milk; including the selection and feeding of cows; the making of butter and cheese; the feeding of calves for veal or stock; and, generally, the different modes of converting milk into a more durable, portable and saleable form. Dairy-farming, in every age, and in almost every country, has constituted a necessary and interesting department of industry. The pastoral life has always been regarded as one of tranquil enjoyment; and poets, both ancient and modern, sacred and profane, have sung its praises, and extolled its pleasures in the most glowing terms. The sacred writers, addressing a pastoral people, could use no stronger language to enforce their meaning, than to exhibit physical and moral beauty under the figurative emblems of "milk and honey." Palestine, a pastoral country, was thus characterized; and we, who live in a mechanical age, can but very inadequately enter into the feelings, or appreciate the language of the writers of Scripture history, in their estimation of a species of food so admirably adapted to the wants of a nomadic life. The wandering Arab—that stereotyped copy of man's earliest physical and mental condition—regards his camel with feelings inappreciable by a European; for he knows that she can convert the hard, bent and withered shrubs of the desert into a food, grateful at all times, and in all countries, but especially so in the parching climes of the East; and the poor Laplander and Siberian, shrouded in snows for two-thirds of their existence, place an equal value upon the scanty produce of the reindeer. The sheep and goat occupy a similar position in the estimation of the inhabitants of the mountainous countries of Asia and Europe, and browse in safety on the verge of precipices, and in the clefts of rocks, inaccessible to less agile animals—thus enabling man to obtain food and clothing from localities where cultivation is impossible. It is principally, however, in cultivated countries that we find these animals supplanted by the cow, which, as a producer of milk, is in every respect superior to all other animals, both for the quantity she yields, and its adaptation to the taste of every individual; for there are few to whom milk, in some form or other, is not only a necessary, but an agreeable species of food.

Hitherto, the nature of the soil and climate of a country has determined, in a great measure, the choice between tillage and dairy husbandry; thus we find, in moist, low-lying districts, where rich, natural pasturage abounds, that the attention of the farmer is generally directed to the dairy system, almost to the entire exclusion of tillage farming. This is particularly observable on the rich, damp *polders* of Holland, the vales of Gloucestershire, the flats of Cheshire, the meadows of Leicestershire, and also in the dripping climate of the west of Scotland, and many parts of Ireland. These districts, familiarly known as the "dairy counties," are the principal sources of the dairy produce, especially butter and cheese, consumed in the large cities of the United Kingdom. Still, dairy farming is not, by any means, confined to these localities, but is practised by many extensive farmers wherever there is scope for carrying on their operations profitably. A mixed system of tillage and dairy-farming, which combines the excellencies of both, has long been practised in some parts both of England and Scotland; and, viewed in its relation to increased production, it can scarcely fail to become more general, and sooner or later supersede entirely the old dairy system, which has so long remained stationary, and admits of so little improvement. In these remarks, it is not overlooked that there are some soils, such as are to be met with on the marls and lias clays of the vale of Gloucester, so stubborn in their texture, so impatient both of drought and moisture, that to convert them profitably into arable land, in the present state of agricultural knowledge, is considered next to an impossibility. Granting, to a certain extent, the force of the objection, still it does not apply to those districts where the soil presents no such obstacles to its being converted into a mixed system of arable and dairy-farming, and where the farmers have no plea to urge for continuing their present system but that of ancient usage. The dairy farmer is not, however, always to blame for his adherence to old customs; for it is but too generally the case, that he is expressly prohibited by his landlord from putting a plough into his land, lest he should injure its value. So long as these restrictions are in force, so long will the agriculture of these districts remain unimproved, and the landlord's rent, and the tenant's profit, continue in *statu quo*.

The conversion of milk into butter and cheese being, under certain circumstances, a spontaneous act, was, as might be supposed, a very early discovery; and the use of these substances as food was no doubt very common in the patriarchal and pastoral times. Thus we find Abraham entertaining his supernatural visitors with butter, when on their way to warn Lot of the impending destruction of the cities of the plain. Frequent mention is made, in other parts of the Bible, both of butter and cheese, from which it may be inferred that these were as common articles of manufacture and consumption in those early times as they are at present, the principal difference being, that they were generally made from the milk of the camel, the sheep, or the goat, instead of from that of the cow. It is very certain, however, that the quality both of butter and cheese

was very inferior to what it is now, arising from the nature of the milk employed, and the unskillful mode of treating it. The process of making butter among the Arabs and Syrians of the present day—whose customs are considered to differ little from those of the ancient Hebrews—is to put the milk into a copper pan, placed over a slow fire, adding a small quantity of *sour* milk, or the dried entrail of a lamb. After the milk is warmed through, and begins to curdle, it is poured into a goat-skin bag, which is then tied to one of the tent poles and kept constantly in motion for two hours. The butter then separates from the fluid part, and is placed by itself in another skin. In two days after, it is again put into a pan, and subjected to the action of a slow fire, with the addition of *bourgoul*, (wheat boiled with leaven, and dried in the sun,) and allowed to boil for some time, during which it is carefully skimmed. The bourgoul precipitates all the cheesy matter, and the butter then remains quite clear above. This butter is of a white color, and possesses a flavor not at all relished by Americans or Europeans, or, indeed, by any one accustomed to the use of butter made from cow's milk churned in the usual way. The cheese made in Eastern countries is also very inferior. The milk is curdled either by sour butter-milk, or a decoction of the great-headed thistle, or wild artichoke. The curd is then put into small baskets, and pressed. It is excessively salted; and when the cheese is made, it appears in the form of small, round white cakes, without rind, which soon become hard and dry throughout. It is unnecessary, however, to pursue further the consideration of such details, as they are merely curious, without possessing any practical interest to the dairy farmer of the present day. In the meantime, however, the reader's attention will be directed to the present system of management pursued in the more important dairy counties of England.

The principal facts connected with the different modes have been supplied by practical men, thoroughly conversant with this department of farming, and who, at the same time, are residents of the localities of which they speak.

SYSTEM OF GLOUCESTERSHIRE.

A very great proportion, in some cases nine-tenths, of the land, on all the dairy farms in the vale of Gloucester, is under pasture; and the richness of the grass and the mildness of the climate are peculiarly adapted to the production of the finest quality of milk. In consequence of the large quantity of land always in grass, twenty-five cows, at least, are ordinarily kept to the 100 acres, besides the usual number of young stock, reared to maintain the full complement of cows giving milk. With regard to the age at which a milch cow ceases to be profitable, it is considered, by all dairy farmers, that the younger the cow, the richer her milk.

The second and third years are the most profitable, if both the quantity and quality of the milk be taken into account. Thus, supposing a cow to drop her first calf when she is three years old—the usual time—she will be in her prime the following two years; and, if she continue to produce her calf in good season, (from February to April,) she is generally retained in the dairy until seven or eight years old, after which it is not considered advisable, for several reasons, to continue her longer in milk; first, because her milk is fast deteriorating in quality; secondly, she is becoming every year of less value to the grazier; and lastly, which is a point too frequently overlooked, it has been satisfactorily proved, that an aged cow consumes much more food than a young one, particularly in winter, when, as in Gloucestershire, her only food being hay, the extra quantity consumed adds very considerably to the cost of maintenance, while, at the same time, it is not accompanied by a proportional increase of produce. In all herds, however, there are favorites, either on account of their breed or milking properties, which are retained until they are ten, and even twelve years old.

As the *fattening* and *milking* of cows are incompatible in a country where root crops are rarely cultivated, and as it is inconvenient to have farrow cows fattening on the pastures in summer, the cast-off ones are generally sold to graziers or stall-feeders, in November, or as soon as they cease to give milk for the season. The price usually obtained for farrow cows varies from $40 to $60, according to size, age, and condition. About one-fourth of the cows are discarded annually, and their places taken by a corresponding number of young ones; consequently, it is necessary either to rear a sufficient number of heifer calves for this purpose, or to purchase three-year-old heifers in calf—the former being the common practice—as all good dairy farmers prefer rearing a sufficient number of heifer calves from their best cows, to incurring the risk of purchasing heifers in calf.

In the rearing of calves, economy is strictly observed. They are taken from their dams at a week old, at which time two quarts of new milk are given, morning and evening, to each calf, for the first month. After this period, the quantity of milk is reduced to one quart at each time, and half a pound of meal substituted. This diet is continued for a month or six weeks longer, after which, the calves are turned out to the best grass the farm can afford. When calves are fed on milk and meal, it is considered advisable to teach them to eat a little hay as soon as possible, as it is an excellent preparation for grass-feeding, their stomachs not being so delicate as when confined closely to a milk diet. During the first winter, the calves are fed on the best hay, but they are never housed at all, nor even sheltered with any degree of care. After the first winter, the worst grass and fodder on the farm are their only food, until the time of calving, when they have the same fare as the other milch cows. The remainder of the heifer calves, not required to be kept for stock, and all the male calves, are either sold, when ready to wean, to the hill farmers, or, when only a few days old, to butchers. In the former case, the average price realized is about $5 each; and,

in the latter, as low as $2 50, and even $2 each. A three-year-old cow, newly calved, is generally considered to be worth from $70 to $90; and a two-year-old, newly calved, from $50 to $70, which gives an average of $60 and $80, respectively. It is only, however, very large and well-grown heifers that are brought in to calve at two years old—the more general age being three years.

Feeding the Cows.—One acre and a half of pasture grass is the usual allowance to each cow, from May 1st to December 1st. During the winter and spring months, hay is almost the only food given; and, as each cow will consume two and a half tons, it requires the same extent of land—one and a half acres—for the winter as for the summer keep. Occasionally, cut barley straw is given to cows for the sake of economy, when they are not in milk, which usually occurs during the months of January and February. The expense of feeding a milch cow for twelve months is calculated at $20 for grass—one and a half acres in summer; and, as the expense of hay-making and attendance falls to be added to a like quantity of land, the cost of the winter keep is not overstated at $25, which amounts to $45 per annum. No extra food, such as oil-cake, or bruised grain, is ever given to cows, not even turnips nor mangold-wurzel; their solid food, grass and hay, being of Nature's providing. To aggravate the evils of this penurious system of treating dairy cows, they are denied the indulgence of shelter at the very season—the depth of winter—when it is most required, even in the warmest and mildest districts of South England. It is a well-known fact, so well known as not to demand the slightest argument in its favor, that cattle, but more particularly milch cows, are easily injured by exposure to cold; but in Gloucestershire, this is altogether disregarded; for, in general, no accommodation is provided for housing the animals comfortably in cold weather; the common practice being to keep them in the warmest and most conveniently situated fields throughout the winter, where they are supplied with hay twice a day. In wet or snowy weather, the waste of fodder is very great, and, in consequence of the animals being constantly exposed to the hungering influence of cold, a much greater quantity of food is required to maintain the normal temperature of their bodies. than would be necessary were warm, comfortable housing afforded. As things are at present, the dairy farmer is satisfied if, in winter, he can prevent his stock from falling out of condition to any serious extent; and such is the treatment which cows receive in the vale of Gloucester from Christmas to March.

When the cows are about to calve, they are brought home to the sheds and yards, wherever there is room for them, and there supplied with the best hay the farm can produce, but seldom have they a sufficiency of litter to make a comfortable bed. That portion of the cows, for which there is not accommodation in the yards, is turned into the orchards or nearest fields to the homestead, for the convenience of milking and feeding, and remains there until the grass in the other fields is ready for being pastured.

Summer Treatment.—The cows are turned into the pastures generally about the end of April, or the first week of May. The fields adjacent to the homestead are preferred for grazing milch cows, as the fatigue and annoyance consequent on driving them any considerable distance not only lessens the quantity of milk, but also deteriorates the quality of the cheese made from it. Most dairy farmers endeavor to change their cows from one field to another as regularly as possible, and also to have one or two fields shut up, in order that the grass may grow and get clean, while the others are being eaten down. The cows are thus supplied with fresh, clean pasture every ten days or fortnight, throughout the summer—a point of the utmost importance, both as regards the quantity and the quality of their produce.

Towards the end of summer and in autumn, when the pastures begin to fail, and the grass gets hard with the drought, the cows are allowed access to the meadows, from which hay has been mown, the aftermath of which affords a supply of short but nutritious herbage. If the pastures have not been overstocked, the yield of milk is very uniform for five or six months, and there is also little difference in its quality. Either to overstock or understock pasture is considered an evil; in the former case, the grass will be scanty and foul, and in the latter, coarse and ill-flavored, so much so as greatly to impair the quality of the milk.

A great and serious evil in the vales of the Severn and Avon, where access to these rivers is not attainable, is the want of good, soft, running water. In the heats of summer, the cows are too often forced to drink from dirty ponds, where the water is befouled by the drainings of the dung "courts," or red with the washings of the heavy clay soil, still further aggravated by being constantly trodden and waded through. Artificial shade is also greatly needed, as that which is afforded by the trees is rendered useless to cattle, by the buzzing and bites of insects, which also congregate there for shelter.

Dairy Operations.—The operation of milking the cows commences in the summer at five o'clock in the morning, and again at three in the afternoon, and is completed in about one hour each time—nine cows being alloted to each milker, the dairy-maid usually assisting. As soon as the milk is drawn, it is carried to the dairy-house, strained into the cheese-tub, and the rennet and arnotta mixed with it. The rennet is prepared in several different ways. In Gloucestershire, the cleaned stomach of a calf is salted, pickled, and dried; and when at least a year old, it is well sodden in salt water, half a pint of which proves enough to coagulate 50 gallons of milk. In Ayrshire, the contents of the stomach are preserved; they are well salted, both inside and out, and dried for a year or more; and, when needed for use, the whole is chopped up, and placed with salt in a jar, along with water and new whey, which, after two or three days, is strained to remove impurities, and is then ready for use. In Cheshire, the skins are cleaned out, and packed away with salt in an

earthen-ware jar till the following year. They are then taken out a month before use, and three or four square inches of skin are steeped during the night in half a pint of salt and lukewarm water, for use in the morning, along with 60 gallons of milk.

The scientific principles involved in the important manufacture of cheese are not generally known. Milk contains about 4½ per cent. of casein, which is the principal ingredient of cheese. This casein is almost exactly of the same composition as animal flesh. It is held in solution in the milk by means of an alkali. Any acid which removes this alkali, converts the casein into an insoluble curd, which, when collected and dried, forms cheese. Muriatic acid is used for this purpose in some parts of Holland; vinegar, tartaric acid, cream of tartar, and even some of the salts of oxalic acid, such as salt of sorrel, are employed in various countries. The acid formed, when milk becomes sour, also produces the same effect, so that sour milk is used instead of rennet in some parts of Switzerland. All these additions are for the express object of making an insoluble curd, by removing the alkaline solvent of the cheese. This insolubility may also be produced indirectly, as well as directly. Various substances have the property of forming an acid in the milk itself, (lactic acid,) which, removing the solvent of the casein, causes the proper formation of a curd; for most kinds of cheese, this indirect action is preferred. In other countries, the coagulation, or curding, is effected by various means, as by the juice of figs or thistles, or by decoctions of the flowers of the artichoke, of the crow-foot, and of the white and yellow bed-straw. A peculiar stringy curding is obtained by the juice of the butterwort (*Pinguicula vulgaris.*) But, in England, it is usual to depend on the peculiar action of the rennet. The stomach or intestines of young animals, especially of the suckling calf, pig, lamb, or kid, have been found to possess this indirect action. Little is known as to the exact chemical processes which ensue when rennet is added to milk. In fact, all known is, that the stomach, dried and prepared as rennet, must be in a state in which it may decay, but not rapidly enough to run into putrefaction. The active principles of the rennet are certainly substances in the act of decay, and its peculiar value is that it can be preserved without losing this power, which, though in abeyance, may be called into activity when desired. The processes used in preparing the rennet—such as salting, smoking, treatment with salt, lemon-juice, and spices—have for their object the prevention of putrefaction and the repression of decay. A certain amount of decay is necessary; and, for this reason, rennets are preferred in most districts, when they have become somewhat aged by keeping. The active changing principles are soluble, and, therefore, may be extracted by water, and used directly for the curding of the milk; or the rennet itself, being added to the milk, gives out its soluble ingredients to that fluid. A further decay of the exhausted rennet produces more of the transforming materials, and restores it to its active state, so that it may be used over and over again. Chemists, at present, know the fact, without having ascer

tained its cause, that decaying substances, such as putrid flesh and sour milk, produce a change in fresh milk; forming, among other substances, various acids which effect its curding, or coagulation.

Prepared rennet is a means of effecting this change in a regulated manner, and without the production of those offensive substances formed during the putrefaction of milk. It is by the communication of the decay of the rennet to milk—just as a decayed apple causes decay in a fresh apple in contact with it—that this change is effected, and not by the addition of any peculiar substance; for it has been found by experiment, (Berzelius,) that one part of rennet, which had curded 1,800 times its own weight of milk, had decreased in weight only 0.06. This view is obviously correct, when it is considered that one square inch of good rennet can curdle 80 quarts of milk, or that one spoonful of its infusion produces the same effect on 120 quarts. The action finds its parallel in that of yeast on sugar. In this case, a very small quantity produces the alcoholic fermentation on an immense amount of the saccharine fluid. There can be little doubt that the manner of preserving the rennet produces a very great effect on the qualities of the cheese. It is much more probable that the different kinds of decay, caused by rennets differently prepared, have much more influence on the character of the cheese of a district than any deviations in climate or in pasture. As the cheese of commerce does not consist simply of casein, but also contains butter and other ingredients of the milk, in small proportions, it is obvious that the qualities must depend much on those of the milk itself. The milk of cows, goats, and ewes has very different composition and properties, and cheese made from them differs also very materially. Minor differences in the milk of the same animal also produce notable variations in the cheeses of different districts, even though apparently the same materials are used in their preparation. The differences are, of course, much increased, according to the practices of districts, of adding or subtracting cream from the milk used. The former method gives the rich Stilton cheese, while the removal of all cream yields the poor, horny cheeses of Essex and Sussex. The use of whole milk produces such cheeses as those of Gloucester, Cheshire, Wiltshire, Cheddar, Dunlop, and the Gouda of Holland. The common Dutch cheeses are usually obtained from once-skimmed milk, so that they still contain butter, but less than the varieties just named.

In the preparation of cheese, the application of heat to the milk is useful, by hastening the chemical action, and by enabling the whey to separate more readily, and yield its butter to the curd. The more or less complete separation from the whey has an influence not only on its taste and power of keeping, but also on the flavor which the cheese acquires by age. The alterations resulting from curing, and from the time required for ripening the cheese, have not yet been sufficiently investigated to be explained on scientific principles, although chemists have recognized various bodies as the result of these changes. The pungent smell and taste are obviously due to the volatile acids in butter, though, doubtless, other unknown

bodies contribute to their production. Valerianic acid, and a crystaline substance called leucin—ammonia, partly combined with casein and partly as salts—have also been detected. All these ingredients exert an important influence in giving character and flavor to cheese. The caseous ingredient of milk is not confined to that fluid, but exists even more abundantly in peas and other leguminous seeds. But the absence of butter, and the difficulty of forming artificially the due proportion of these, and other accidental ingredients, have prevented the application to other powers of casein for the purpose of cheese-making.

Cheeses are reduced in value when taken possession of by insects, being rendered disagreeable to many house-keepers; and it is possible they become unwholesome food; for the eggs of certain flies may be thus introduced into the human stomach, where they live until they are full-grown. The maggots of a sort of flesh-fly (*Musca corvina*) sometimes inhabit cheese, as well as those of the bacon beetle (*Dermestes lardarius.*) Mites may be considered an exception, as they seem to enhance the value of this article, at least in the estimation of the man of taste, but it certainly is not economical to maintain such hosts of unprofitable visitors. The most injurious, however, are the "hoppers," which are maggots bred from eggs laid by a small fly called *Piophila casei.* If it be desirable to preserve cheese from such depredations, the rind should be frequently and well brushed; and all fractured or injured cheese should be removed from the stock it is intended to keep for any length of time.

To return to the operations of Gloucestershire dairying: In autumn and winter, when the weather is cold, a small portion of the milk is warmed in a tin pan or pitcher in order to bring the whole to the proper temperature (85° F.) before adding the rennet. The milk is then allowed to remain perfectly still for an hour, and, during all this time, it is kept carefully covered with a woollen cloth to exclude currents of cold air. If all has gone well, the curd will then be completely formed and ready for being broken up. The breaking is effected by passing a three-bladed knife or a coarse wire sieve gently downward to the bottom of the tub. After the curd has been cut through and subdivided as equally and as minutely as its suspension in the whey will admit, the whole is allowed to remain undisturbed for ten minutes, or so, in order that the broken curd may sink sufficiently to allow the whey to be baled off the top. As soon as all the clear whey has been removed, the curd, now much more condensed, is broken a second time, but much more slowly than before, to avoid pressing out any of the butter, which would undoubtedly occur were the cutting of the curd to be done roughly or rapidly. When the curd has been properly broken and reduced to an equal degree of fineness, it is allowed to settle for a short time, after which more of the whey is removed, and poured through a sieve, to retain any small particles of curd that may still be suspended in it. When most of the whey has been removed in this way, the curd is divided into lumps and laid aside one upon

the other in the bottom of the tub, which, being placed a little atilt, allows the whey to escape to the lower side and be removed. When the whey has ceased to drain off, the curd is ready for being placed in the vat.

A cheese-cloth, made of fine canvas is spread across the mouth of the vat; the curd is then lifted from the tub by the hands and laid upon the cloth and pressed equally down. When all the curd has been placed in the vat, the ends of the cheese-cloth are tucked up and folded inwards, with as few creases as possible on the top, and covered with a circular board, made exactly to fit the inside of the vat. It is then put in the press for half an hour and lightly pressed, after which the partially consolidated curd is taken out, cut in slices, and passed through the curd-breaker, which reduces it to small crumbs without squeezing out the fatty matter. The comminuted curd is again returned to the vat, and firmly pressed into it by the hands while filling. A dry cheese-cloth is next placed over the mouth of the vat, which is then turned upside down, and the curd turned out upon the cloth. The vat is now rinsed with whey and dried, and the curd still in the cloth placed in it. The ends of the cloth are then folded neatly and evenly over the top as before, and covered with the cheese-board, or another cheese-vat, if more than one cheese is to be placed in the same press. The vat is allowed this time to remain two hours under the press, when it is again taken out, and the cheese, now in a fine, solid state, is pared at the upper edges if necessary, thereafter inverted and put in a clean, dry cloth, and again pressed. There are usually two or three presses employed, each heavier than the other, and ordinarily it takes about four or five days for a cheese to go through these presses, beginning with the lightest and ending with the heaviest.

Salting.—After the cheese has been twenty-four hours in the press, it is ready for receiving the salt; but some apply the salt in twelve hours. As a general rule, the salt should not be applied until the rind of the cheese is firm and free from openings, as these openings never close completely after salting, however great a pressure may be applied. The salting is effected by the hand, the salt being rubbed over the whole surface of the cheese as long as it continues to take it in, after which it is again wrapped in a dry cloth and put under the press. In another twenty-four hours, it is again salted as before; but this time it is put in the vat without a cloth and pressed, in order that a smooth and even surface may be obtained. A third and final rubbing with salt is given at the same interval, and the cheese, being pressed as before, is then ready for being removed to the drying room. When cheeses are salted in this way, it takes a pound of salt to 32 pounds of cheese.

Drying.—A dry-room, or loft, is, or should be, specially appropriated to the drying of cheeses. The cheeses, as they are removed from the press, are laid either upon shelves, racks, or on the floor,

and are well wiped with dry cloths, and turned every twelve hours for two or three days. After this, they are only wiped and turned every twenty-four hours, and in a month after leaving the press they are ready for being scraped and painted; the latter operation being performed only when the cheeses are intended for the London market. The paint employed is either Indian red or Spanish brown, or a mixture of both with small beer, which is rubbed on with a woollen cloth.

Mr. Morton, in his "Report on Gloucestershire Farming," gives the following as the marks of good Gloucester cheeses: The "blue coat" which rises through the paint on their sides, and, what is a sure sign of their richness and sweetness, the yellow, golden hue of their edges, a smooth, close and waxlike texture, a very mild and rich flavor, not crumbling when cut into thin slices, nor parting when toasted, with the oily matter they contain, but softening without burning. If cheese has been soured in the making, either from being too long in hand, or from want of attention in scalding the utensils, nothing will cause it to assume the blue coat.

The following remarks by the same writer, are also worthy of attention, especially by cheese makers in Scotland, where the general practice is to salt the curd when broken down the last time:—"If the curd is salted when ground down, before being put in the vats, the salt has the effect of giving a skin to each of the particles of curd it comes in contact with, which prevents them from intimately uniting; and although the curd may be pressed together and become good cheese, yet it never becomes a close, smooth, solid mass, like that which is salted after it is made, but is of a loose texture, and crumbles when cut; and, although it may be equally fat, yet in toasting, the oil melts out of it, and the cheesy part burns."

Butter-making.—The quantity of cream butter in dairies where cheese of the best quality is made, is very small. About one-fifteenth part of the milk is allowed to remain one meal, or twelve hours, when it is skimmed immediately before the making of the cheese commences, and of which it forms a part, along with that newly brought in from the cows. The cream taken from this small portion of milk is shifted once a day, from one vessel to another, (to prevent a skin forming on its surface, which is considered to injure the quality of the butter,) and churned twice a week. The *whey* cream is also churned twice a week, but it is allowed thirty-six hours to rise before being skimmed off. The quantity of whey butter averages weekly about a pound per cow during the summer months. Mr. Morton gives 16 pounds of cream butter, and 25 pounds of whey butter, as the average annual produce per cow, on a large dairy farm in the vale of Berkley.

Dairy Utensils.—The utensils employed in Gloucestershire vary little from those used in other counties. They consist of the "milk-pail," the "cheese-tub," the "sieve," the "cheese-vat," and "cir

cular board," locally called "suity-boards," (Scottice, "leaks") "skimming-dish," and bowl. The milk-pail is made of maple, and will hold about six gallons. The cheese-tub is of a size sufficient to hold the milk of which the cheese is to be made. The cheese-vats are made of elm, turned out of the solid wood, and are of various sizes. For "Double Gloucesters," (five cheeses to the 100 pounds,) the vats are 15½ inches in diameter by 4¼ inches deep; and for "Single Gloucester," (eight cheeses to the 100 pounds,) the size is 15½ inches diameter by 2½ inches deep. The only difference in the manufacture of the two kinds is that arising from the size of the article; and the only difference of quality is owing to the longer period during which the thicker cheese must be kept in order to ripen.

The greatest attention is paid to cleanliness in the Gloucestershire dairies. The floor is kept as dry as possible, and the temperature as uniform as circumstances will admit. The proper temperature is considered to be about 60° F., but this is seldom attained in winter and spring.

Yield of Milk, Cheese, and Butter.—From 500 to 550 gallons of milk is considered to be about the average yearly produce per cow in Gloucestershire—the months of May, June, and July being those in which the largest quantity is obtained. Very little "Double Gloucester" cheese is now made; that termed "single" being more profitable to the farmer, and not materially of less value to the consumer.

The "Single Gloucester" is much the more general sort made, as it is ready for use when two months old; while the "Double Gloucester" requires to be kept nine or twelve months before it is ripe, so that the additional price it realizes does not compensate for the loss of weight sustained by so long keeping.

The annual quantity per cow is from 300 to 350 pounds, and as before stated, from 40 to 50 pounds of cream and whey butter are also made; and these, with the whey used for feeding pigs, constitute the annual produce of a Gloucestershire dairy cow, to which is to be added the value of the calf and also of the manure.

The quantity of cheese and butter stated above does not, however, represent the whole of the milk yielded by each cow; for it must be kept in view that a number of heifer calves are required to be reared every year to keep up the stock, and which consume a considerable quantity of the milk that otherwise would have gone to increase the amount of butter and cheese. The annual average quantity of milk per cow, is computed, by an experienced farmer, at 525 gallons; but, as a gallon of full milk will make a pound of cheese, the whole quantity of cheese that can be made from the milk of a cow, supposing none of the milk to be applied to other purposes, would be upwards of 500 pounds, instead of less than 400 pounds, as above stated. From this it appears that only about four-fifths of the milk of a Gloucester dairy is available for the making of cheese and butter, the remainder being consumed by calves, and

by the farmer's family and servants, as a necessary every-day article of diet.

SYSTEM OF CHESHIRE.

The Cheshire dairy system is, in many respects, similar to that pursued in Gloucestershire, for which reason, and to avoid repetition, our remarks will be confined to what is peculiar in the Cheshire system: The Cheshire dairy farmer is prohibited, by his tenure, from having more than a fourth, or, at most, a third, of his land in tillage. In the former case, twenty-five cows are kept to the 100 acres, and in the latter about twenty. This is exclusive of the young heifers required for keeping up the stock of cows to the full number. These heifers have their first calves when three years old, and, if they prove good milkers, are kept for ten or twelve years; but, if deficient in milking qualities, they are seldom retained longer than two years. The value of a good young heifer at calving is about $60 to $70; and if milked for ten or twelve years, she will then seldom fetch more than $15 or $20. Old cows are generally sold lean in October; hence the low price they bring.

The calves not required for stock are sold at three weeks or a month old, about half-fed, at prices varying from $7 25 to $7 50 each. Some farmers keep their calves for six or seven weeks, when they realize from $12 50 to $15 for them. Good heifer calves, from good stocks, bring $5 each, when dropped early in spring, but the greater part of such are reared and kept for cows. Late spring calves are usually sold to persons having one or two cows, at prices varying from $2 50 to $5, according to breed, color, &c.

Treatment of Cows.—In winter, (November 1st to May 1st,) the cows are tied up in stalls or close "shippons," but are generally turned out a few hours every day to a near field for air and exercise. Some farmers merely turn them out to water twice a day, and then tie them up again as soon as they have drunk. On clay farms, the ordinary food for "dry" cows is wheat straw or oat straw. A week or two before calving, hay is substituted, and afterwards the mother is fed for some time on bran mashes; then about half a bushel of oats a week is given, a little every day, and in some instances a small quantity of turnips or mangold-wurzel is added; but the cases where roots are given to cows are exceptions to the general rule, which is to feed with hay and cut grain. On the sand-land farms, however, the use of turnips (generally Swedes) for feeding cows in winter is more common. The tops are consumed first, with straw, and the bulbs afterwards, with hay. The allowance per cow is about 28 pounds of roots daily, and from 1,200 to 1,500 pounds of hay during the three spring months.

On the sand-land farms, the usual time for turning out cows to

grass is about the 1st of May; and on the clay farms nearly a fortnight later. Two acres of pasture are allowed to each cow, exclusive of the aftergrass on the meadows from which a crop of hay has been taken, and which may extend to half an acre for each cow. On good soils, and—what is worthy of remark—on land recently manured with bones, an acre and a half are sufficient for a cow. The use of bone manure, therefore, may be considered as equivalent to an increase of produce to the extent of 25 per cent., or, in other words, 75 acres boned will keep as many cows as 100 acres not so manured.

The cost of keeping a cow twelve months in Cheshire is estimated at $45; or $17 50 for the six summer months, and $27 50 in winter.

Cheese is the principal product of the dairy; indeed, no butter is made except from whey, which, as the cheeses are made of full milk, or nearly so, is very rich. The average quantity of cheese made annually from each cow is estimated at 300 pounds; but instances are quoted of 400 pounds, and even 500 pounds, as the average of some small and very select dairies. This is exclusive of what milk is required for rearing calves and family use, so that if, as in the case of Gloucestershire, allowing one-fifth of a cow's yearly produce, and supposing the whole to be made into cheese, the quantity would be raised considerably, and 460 pounds may not be too high an average.

Cheese-making.—The cows are milked twice a day (at 5 A. M. and 5 P. M.) The cheese being always made in the morning, the evening's milk is poured into basins, or coolers, and stands over till then. It is then skimmed, to remove the cream; and a portion of it, about one-half, is warmed in a flat-bottomed shallow pan, to about 100° F., and poured into the cheese-tub, along with the morning's milk, and that portion of the evening's milk not warmed. The cream, mixed with a little warm milk, is now added, and the temperature of the whole being somewhere between 80° and 85°, the rennet and coloring are also added, and well stirred and mixed with the milk. The arnotta, or coloring matter, used in the preparation of Cheshire and other cheeses, is added to the milk before the rennet. Half an ounce to about 75 pounds of cheese is a sufficient quantity; which is commonly dissolved in a pint of warm milk, on the previous night, for addition to the bulk in the morning. After the addition of the rennet, the tub is covered carefully up for an hour; by which time, under ordinary circumstances, coagulation will begin, and in fifteen minutes more be completed. The curd is now broken; which, for a sixty-pound cheese, takes about twenty minutes, and is then allowed to rest fifteen minutes, to separate from the whey. The whey on the top is removed by pressing down a flat-bottomed pan gently on the curd, and allowing it to fill. The whey is poured into the "set-pan" from the cheese-tub. The curd, so far freed from the whey, is again broken by the "breaker," or very gently by the hand, and again allowed to settle and separate. In about half an hour, the whey is baled out, and, as the curd gets more and more

solid, it is drawn to one side of the tub. When this has been accomplished, and the free whey all removed, a semi-circular perforated board, made to fit one-half of the tub, is placed upon the curd, and pressed down with a thirty-pound weight, which gently squeezes out the whey. This whey is poured through a sieve into the set-pan, to detain the particles of curd floating in it. The weight is now removed, and the curd cut in pieces six or eight inches square. The board and a weight, double the last, are again applied. More whey is pressed out, and, when this has been repeated once or twice, with heavier weights, according as the condition of the curd requires, the curd is ready for being put into the cheese-vat.

Pressing.—Before placing the curd into the first or large cheese-vat, a willow basket is sometimes used; the curd is cut into smaller square pieces than before, and gently broken by the hand in the act of putting it in. When put into the vat, which it should not quite fill, it is covered with a close-fitting board, and placed under a light and continuous pressure. When the whey ceases to drain from the sides of the vat, the curd is taken out and broken as before. It is now put into the proper cheese-vat; but, before this, a cheese-cloth is placed in the vat. After the curd is all in, the ends of the cloth are tucked over it, then covered with the "sinker," or circular board, and placed under heavier pressure than before. To assist the discharge of the whey, iron skewers are thrust through the vat-holes into the cheese, and, after a few minutes, withdrawn, when the whey follows. When the whey has ceased to follow the skewers, on being withdrawn, the vat is taken out; the curd, still in it, is cut into sections, every two or three inches, with a dull-edged knife, and again pressed and skewered, as before, for a quarter of an hour or twenty minutes. After this, the curd is taken entirely out of the vat, cut into large pieces, each of which is broken by the hand, then placed in a dry cloth in the vat, and covered, pressed, and skewered; and this is again repeated, until the whey is nearly all extracted. These operations, from the time of coagulation, will consume about five or six hours, by which time the curd should be sufficiently dry for being salted.

The best tests of complete coagulation are the firmness of the surface of the curd when pressed by the hand, or skimming–dish, and the pale-green color of the whey.

Salting.—The curd, being now comparatively free from whey, is taken out of the vat, cut into pieces, and crumbled down with the hands; or, what is better, by passing it through the curd-mill. The salt, at the rate of a pound to 46 pounds of curd, is then intimately mixed with it. The salted curd is again returned to the vat in a dry cloth, of finer texture than before; and, in order that it may be pressed properly, it should more than fill the vat. A tin hoop is put round that part of the cheese which projects from the vat, the lower edge being within the vat, and sinking along with it when put under the press. The pressure is now considerably in-

creased, and the skewering continued. In an hour, the cheese, being completely formed, is taken out, its edges pared—the parings put in a hole on the top, scooped out for the purpose—inverted, and put into the vat, a dry cloth having been previously placed in it, and again subjected to heavier pressure. Some time during the evening, the cheese is again turned, and receives a dry cloth, which terminates the first day's operations. On the second day, it is turned twice or thrice, dry cloths given, and the skewering continued. On the third, this turning and dry cloths are twice repeated, but the skewering is discontinued. This usually completes the process of making, but some continue the pressure for another day. External salting is more practised in Cheshire than salting the broken curd; but, as the mode of doing so has already been detailed in the Gloucestershire system, it is unnecessary to introduce it again.

Making of Whey Butter.—The whey is heated, in a set-pan, to 180° F., and frequently stirred, to prevent it burning. When it has reached this temperature, a little sour butter-milk and "thrustings," (white whey,) a pint of the former and 2 quarts of the latter, to 22 gallons of whey, are thrown in, upon which the cream immediately rises to the surface, and is skimmed off and put in a jar to sour or clot. In a few hours, after being placed in the jar, the thicker and more oily part of the cream rises to the top, and the thin, wheyey matter is withdrawn by a spigot from below. In three or four days, the cream is completely clotted and ready for being churned, which is effected in the usual way.

There will be 90 gallons of whey from 100 gallons of milk, yielding 10 to 12 gallons of cream; which, when churned, will give from $3\frac{1}{2}$ to 4 pounds of butter; but this is probably below the average.

SYSTEM OF LEICESTERSHIRE.

The rich pasture land of Leicestershire affords ample scope for carrying on the dairy system successfully and profitably. Stilton cheese is made principally in the northern and eastern districts; and what is termed "Leicester cheese" in the South and West. The neighborhood of Melton is celebrated for the former; and the villages of Sapcote, Acton, and the vicinity of Marked Bosworth, for the latter. The cows kept are either of the "Long-horned" and "Durham" breeds, or a cross between the two; the former being considered the best milkers, and the two latter as more valuable for their early maturity and aptitude to fatten.

The size of dairy farms in Leicestershire is various; so much so, as to range from 10 to 500 acres. The average extent may be

somewhere about 200 acres, on which, a considerable portion being in tillage, fewer cows are kept in proportion to the land than in Gloucestershire and Cheshire. The number of cows on the principal dairy farms of Leicestershire varies from twenty-five to forty-five, according to the size of the farm.

The length of time they are kept for milkers depends altogether on circumstances. If they prove good milkers, they are continued year after year, until they begin to fall off; but if deficient, they are disposed of at once, however young they may be; though some dairy farmers make a rule of turning off all their cows after the third calf—a practice which corresponds with that of many farmers in Gloucestershire—because, by doing so, the quality and quantity of the milk are always kept at a maximum, and, besides, the cow is easily fattened, or brings a good price when sold to the grazier. On small farms, the discarded cows are generally sold lean, but, on larger ones, they are fattened.

Feeding.—The common practice is to stall-feed in winter, and to graze in summer. The kind of winter food varies greatly on different farms, but the usual practice is to give straw, cut with a small quantity of hay, saturated with linseed boiled in fifteen times its volume of water, and generally having some bran or oat meal in addition. When in milk, the cows are fed with mangold-wurzel, and receive also an increased quantity of meal and bran. To each cow is given daily about 24 pounds of hay, when no roots are given, or 18 pounds of hay, with 40 pounds of roots; and, if the hay is mixed with straw, in equal proportions, 60 pounds of roots are given; but 80 pounds of roots are allowed when the fodder consists wholly of straw.

Clover and Italian ray-grass are given early in spring, and throughout summer and autumn the cows are pastured, sometimes receiving in addition vetches and clover, when these are abundant. Three acres of pasture are allowed to keep a cow from May 1st to October 1st, which, at $8 75 per acre, costs $25, for the summer's grass. The expense of the winter keep is not so easily known, as the mode and kind of feeding on one farm differ so widely from that of another. It is allowed, however, that the keep of a cow in winter, is much more expensive than in summer, the cost of roots, hay, and meal not being below $36, while attendance, interest on capital, &c., will probably raise the expense to $75 per annum. This, however, is high feeding; and, as an offset, we often find 500 pounds of cheese as the annual yield of a cow in Leicestershire; besides, there is a large quantity of rich manure made in winter and during the summer, when the cows are supplied with green food in their stalls. Three hundred and sixty pounds may, no doubt, be much nearer the real quantity made, but this is exclusive of all the milk which goes for domestic purposes, and the feeding of calves. Were every drop of milk converted into cheese, there is good reason to believe that the yearly produce of a well-fed dairy cow is not less than 500 pounds.

Making of Stilton Cheese.—In general, one cheese is made daily. The night's milk is set aside to cream, and in the morning it is skimmed, and the cream added to the new milk. The whole is now made of a proper temperature, (84° F.,) and the rennet is then added. The curd is fully formed in one hour and a half; if formed more quickly, it will be poor and tough; and, if much longer, it requires to be warmed, which is also injurious. The curd is not broken up in the common way, but is carefully removed in slices by the skimming-dish, and placed upon a canvas strainer or sieve. When the curd has been all placed on the strainer, the ends are tied up, and the whey pressed out by gently twisting round the whole mass—the ends being stationary, and suspended on a stick laid across the cheese-tub. It is allowed to drain until the next morning, unless the weather is very warm, when the curd should be removed from the strainer, and placed in a clean dish in a cool place, where it is cut in thin slices, and put into a hoop made of tin, perforated with holes, and rather larger than the intended cheese. A clean strainer or cloth is put between the hoop and curd; and, as the slices of curd are laid in, a small quantity of salt is sprinkled between every second or third layer. The hoop containing the curd rests on a clean cloth, and is covered with another, but no weight is applied to extract the whey. Next morning, the curd is taken out of the hoop, clean strainers and cloths are applied; it is then inverted and placed in the hoop as before, and afterwards pricked with iron skewers in the sides, to facilitate the extraction of the whey, and drying of the curd. These processes are repeated for four or five successive mornings, until the curd becomes firm. During this consolidating process, the cheeses are kept in a warm place, and, in cold weather, they are set in tins before the fire, or in heated ovens constructed for this purpose. It is necessary, for the perfect extraction of the whey, that the drying temperature be raised to about 100°. The utmost cleanliness and care are indispensable during the whole process. The whey should have a free run from the curd, and the strainers should be washed, and then dried thoroughly in the open air, every time they are taken from the curd.

When the cheese has become sufficiently firm, it is pared and smoothed. The inequalities in the sides, where the slices join, are filled up by parings from the projecting parts, and the top and bottom are also smoothed by paring with the knife, and placing them alternately on a flat board. A strong fillet of canvas, long enough to encircle the cheese two or three times, is then firmly bound around it, and held tight by strong pins; a clean dry cloth is also placed under and above it. The binders and cloths are removed every morning, and all cracks filled up. These operations are continued until the outside becomes hard and wrinkled, or "coated," as it is termed. After this, the cheeses are removed to the drying room, where they are regularly turned and cleared from mites. In warm weather, the flies are apt to attack cracks or soft parts of the cheeses; and when this occurs, the best plan is to scoop out the affected part, fill it up

again with the soft part of another cheese, kept for the purpose, and cover carefully with cloths.

As the making of the common Leicestershire cheese differs little or nothing from the mode pursued in Gloucestershire and Cheshire, it is considered unnecessary to enter into detail on the subject, as it would be, in great part, merely a repetition of what has been already stated.

The experience of the Leicestershire dairy farmers with regard to the quantity of cheese from a given quantity of milk, is much the same as in other dairy counties; that is, a gallon of full milk to a pound of marketable cheese. In autumn, a gallon of milk is estimated to produce 18 ounces of cheese.

SYSTEM OF DORSETSHIRE.

The plan pursued in the management of dairies in Dorset differs from that of most other counties. On tolerably-sized farms, consisting partly of sheep, corn and dairy land, the cows are let off to dairymen at an average of $47 50 each per annum, commencing at Candlemas (February 14th.) The price is sometimes regulated by the price of butter; as many pounds being charged per cow, as butter sells for pence per pound at a particular period of the year. The lessee, or dairyman, has a portion of the farm allotted to him, generally one and a quarter to one and a half acres for each cow for summer keep, where the land is of average quality, or one acre on very superior land—which is called the cow lease. About the same quantity of meadow-land is allowed in the fall of the year, and as much hay as the cows will fairly consume from calving time to May 12th, at which time they are turned into the cow lease.

The only control the farmer has over the dairy land is after the cows cease to give milk for the season, and are kept in the straw "barton," or yards. He then turns sheep into the pastures during the winter months. The dairyman is supplied with a suitable house and premises, and a quantity of fuel is provided by the farmers for such purposes as may be required. The rent for the cows is paid quarterly, namely, at May 14th, August 14th, November 14th, and February 14th.

The calf will sometimes pay the first quarter, and the remaining three must be made up during the summer months. The rearing and fattening of pigs also form a considerable source of income to the dairyman. He is expected to work on the farm in hay-time and harvest, also to assist in sheep-shearing and other occasional work. For such work he is paid the same as a common laborer.

Cows.—The kind of cows most common in Dorsetshire, especially in the western district, is the Devon breed. They are mostly of a

red color, kindly in their nature, hardy in constitution, and good for milk, but not of large size. During the last few years, several other breeds have been introduced, such as the Hereford, Durham, and Ayrshire, but the greater proportion from the Channel Islands and France. The latter are great favorites with those who keep only one or two cows for domestic use, as they yield a good deal of cream. It is a common practice to keep one of these cows for every ten of the home breeds, as the quality of the milk is considerably improved thereby.

Calves.—The fattening of calves is also carried on by the Dorset dairymen; and, though not large sized, the veal is of superior quality. A considerable number of fattened calves are sent to supply Exeter, Plymouth, and other markets during the months of February and March. Heifer calves are often sold to the Devonshire graziers, who keep them two or three years and then sell them as Devon cows. About one heifer calf in five is generally retained for keeping up the stock of cows.

Cheese and Butter-making.—When the milk has stood twenty-four hours, the cream is taken off, and the skimmed milk made into cheese. The Dorsetshire cheeses turn mouldy in a few months, but are pleasant to the taste, and are preferred by many to the richer qualities of other districts.

The cream is never scalded nor clotted, as in Devonshire, but is churned in its natural state in the usual way. The following is the system adopted, in this respect, in some parts of that county:—The pans of milk, containing 10 or 12 quarts each, are, after standing for ten or twelve hours, placed for a while upon a hot iron plate over a stove until the whole of the cream is believed to have formed upon its surface, and until, on removing it near the edge, the air-bubbles are seen rising through the milk and collecting under and blistering the coating of cream. This indicates the approach of the boiling point; and the vessel is removed and allowed to cool for some hours, after which the cream is lifted off, and either churned or stirred in an open vessel, with the hand or with a piece of wood about a foot long, until the butter collects, which it does much more easily than from cream collected in the ordinary way. This butter contains more caseous matter than the common kind, but does not keep so well.

Dorsetshire has been long famed for the excellence of its butter, and at one time commanded a preference in the London market, and even yet it is not surpassed by that of any other county. A change has taken place in the mode of preparing the butter for market. Instead of salting it in summer, and sending it to London in autumn and winter, as was formerly the case, it is sent off there or elsewhere twice a week and sold fresh. This is so far an advantage to the dairyman and factor, as there is less risk in the sale.

SYSTEM OF AYRSHIRE AND WIGHTONSHIRE.

The system of dairy-farming, as carried on upon arable farms in these and the adjoining counties, is frequently combined with the rearing and feeding of stock. The progress of agricultural improvements, and the increasing extent of green crops, enables the farmer to unite the two systems, by which he obtains both a better variety of produce for the market and of stock for the farm, than is offered by the more common plan of dairy-farming exclusively. But in particular situations, the latter system is alone practicable, and the nature of the farm will, therefore, decide the mode of management.

The Ayrshire breed of cows is, almost exclusively, the kind used on dairy farms in this district. Breeders have long directed their attention to the perfection of this animal as a milker; and the large stock of cows kept by the dairy farmers in the west districts of Scotland, affords great facilities for commencing the dairy system. The Ayrshire cow is a hardy animal, of small size, but yielding largely in proportion to the food she consumes; is easily fed fat, when no longer profitable as a milker; and produces a very thriving half-breed animal when crossed with a good shorthorned bull.

In proceeding to stock a dairy farm, the usüal mode is to buy from the breeders, in the month of April, a lot of Ayrshire "queys," (heifers,) which have just completed their second year. If the farm is entered at Whitsuntide, (May,) they are put to the grass, the bull admitted to them about the middle of July; they are grazed during summer and autumn, and housed for the winter about the beginning of November. If the farm is entered at Martinmas, (November,) the stock should be purchased at that time, after having received the bull, as it is of importance to have it accustomed to the farm for some months before the period of calving. A dairy stock seldom thrives well immediately after being removed to a new farm; and this is, of course, more severely felt by the farmer, if the cows are shifted about the beginning of summer, while they are in full milk, as they are then easily affected by a difference of water or pasture. In the end of autumn, the queys, when taken up from the pasture, are housed at night, fed on turnips and straw, and let out for water and exercise, for an hour or two in the day, in winter. They are accustomed to be gently handled in the byres, and as the period of calving approaches, they are carefully watched. After this, the calf is immediately removed; the usual management of newly-calved cows (which need not here be detailed) is adopted; and, as soon as the pasture is ready, the cows are turned out during the day to grass. They are brought into the byre, morning and evening, at regular hours, to be milked; and during very hot weather in summer, if annoyed by flies, they are housed for a few hours in the middle of the day, receiving cut clover or vetches. The second summer, the bull is admitted about the end of June or beginning of July, so that the cows may begin to drop their calves in March and

April, but this is regulated by every farmer as best suits his own position, being found advantageous where there is a demand for milk, and where early feeding can be had, to have the cows calve early; while, in more remote situations, where there is no extensive demand for milk, it is more economical to have the cows calve only a week or two before the grass is ready. When the cows calve early, they are well fed, in addition to a full supply of turnips, with bean-meal, or other farinaceous food, for the purpose of keeping them in high milking condition, till turned out to grass. Cows are kept in good thriving condition up to the period of calving; after that they should be in every way as well fed, and with as much variety of food as the means of the farmer admit; they should be clean and comfortable, and in well-ventilated byres; when at grass, the pasture should be rather under-stocked, and the cows housed in either very hot or very cold weather, and at once supplied with extra food, such as cut clover, or vetches, or early rape, and turnips, whenever the pasture ceases to afford a full bite; and in proportion to the judgment with which these details are attended to, will be the success of the dairy farmer. On large, arable farms, where a dairy stock is kept, the cows are frequently let or "bowed" to a dairyman, or *bower*, who, on certain terms of feeding, &c., agrees to pay a fixed rent for each cow, and manages all the details of feeding the stock, and of manufacturing their produce. The usual amount of feeding agreed on is sufficient pasture during summer, with fodder in winter, and four tons of turnips, (one-half Swedish,) and two bushels of beans, ground, to each cow—dairy utensils, and accommodation, a dwelling house and garden, and, generally, a certain quantity of potatoes for household use, being also provided; and for this, the dairyman, or bower, binds himself to pay so much for each cow, (from $35, to nearly $45 in this district,) according to the quality of the stock, and their food, and the proximity of good markets. This is found a very convenient division of labor, as attention to the details of dairy management is incompatible with a like attention to the details of an arable farm. Old cows, and such as prove bad milkers, are fed off and sold, and their places supplied by young cows, either reared on the farm, or bought from a breeder. In settling with the bower, three queys (that is, cows with their first calves) are reckoned as equal to two cows, and farrow cows as equal to queys.

On farms where the mixed system of dairy and feeding is adopted, the management of the cows is the same as already described, except that the bull is admitted early enough to have the calves dropped in the months of February and March. To obtain early maturity, upon which a great part of the success of this system depends, a shorthorned bull, of good symmetry and breeding, is used with the Ayrshire cow; and the half-breed produced from this cross, if well attended to, can be sold fat at the end of its second year. For the first six weeks, the calf receives as much new milk as it can drink, and, if the cow is fed on rich food, namely, bean-meal, along with a full allowance of turnips, about the half of her milk will sat-

isfy the appetite of the calf, the milk being under this treatment very nutritious. If the cows are let to a bower, a fixed price, generally \$2 50, is allowed to him by the farmer for each calf when dropped ; and the value of the milk, which is regularly measured over to the person who feeds the calves, is deducted in their annual settlement. After the first six weeks, the new milk is partly withdrawn, and the calf then receives, as a substitute, boiled linseed in warm skim-milk ; as soon as it can eat it, a little oil-cake is given in its trough, with cut turnips and hay ; and when turned out to grass, which should be young and juicy, the oil-cake is continued by the best feeders. In winter, it gets as much turnips as it can consume, with an allowance of one and a half pounds of oil-cake per day ; it is grased on a full bite of pasture during the summer ; and finished off the second winter with turnips, and about three pounds of oil-cake per day. When the system is carefully carried out, the two-year-old will then weigh from 630 to 770 pounds, and sell from \$70 to \$90.

The union of the two systems of dairy and feeding is extending, among juditious farmers, on the better class of turnip soils. It enables the farmer to be less dependent on a single variety of produce, and affords a better division of labor, inasmuch as, in summer, while the details of the dairy demand full attention, the young stock are kept at pasture ; and in winter, while the feeding of this stock is the chief employment, the dairy is nearly in abeyance.

The dairy cow thus gives a return of \$14 37½ for a year's outlay of \$25 62½ ; while the half-breed ox, in two years, yields only \$15, from an expenditure of \$65. No charge, in either case, is made for fodder or litter, but the superior quality of the dung made from the more richly-fed stock may, indirectly, compensate the feeder for the loss he appears to sustain by his system.

There are two kinds of farms on which a union of the systems cannot be adopted with advantage. These are stiff clays, on which only a small breadth of turnips can be raised, and dry turnip soils, of inferior quality, which require sheep-feeding to maintain their condition :

1. On a farm of stiff land, for instance, extending to 300 acres, there may be a fifth, or 60 acres, in fallow and green crop. A farm of this size should afford pasture for seventy dairy cows, requiring from 10 to 12 acres of turnips for winter food. The same pasture would keep a dairy and feeding stock, which could not be fed in winter on less than three times this extent of turnips. Now, it might be possible, with ample manuring, to grow a fifth or sixth part of the fallow-break with turnips to advantage, while it might be very imprudent, if not impossible, to attempt to force the growth of so great an extent as three-fifths on this difficult kind of land.

2. On a dry turnip soil, of inferior quality, having 60 acres in green crop, 45 of which may be in turnips, one-third will be sufficient for a stock of seventy dairy cows, and two-thirds will remain on the land to be consumed by sheep. The high condition

thus imparted to the soil will render it capable of yielding excellent pasture to the cows, which it could not do, if the turnips were all carried off the land. But a union of the two systems would require that the whole turnip crop be consumed by the cattle, while, in that case, the farm would have no pasture of corresponding quality to carry them through the summer.

SYSTEM OF FIFESHIRE.

There can scarcely be said to be any system of managing the dairy peculiar to Fifeshire, the making of butter and cheese being merely secondary to the rearing of cattle; yet it presents a very good case for illustrating that mixed system of rearing calves for stock, and the making of butter and cheese of the surplus milk, so general in many counties of Scotland.

The number of cows kept on a farm of 200 acres varies from six to eight, which calve in succession during the three spring months. The beginning of March, however, is considered the best time for calves to be dropped. In addition to these, three or four others are usually purchased from town dairymen, or "cottars," having single cows, so as to have altogether three calves at least to every two cows. Calves are generally hand-fed, and only suckled on rare occasions, such as those dropped in May, in which case, two are suckled by one cow. The hand-fed calves get milk warm from the cow three times a day, beginning with one and a half quarts daily, and gradually increasing the quantity to six quarts at the end of four weeks, and to eight quarts at the end of the next four. After the first six weeks, however, linseed and oat-meal, well boiled together, are given along with the milk, at one or other of the meals—generally night and morning—commencing with a quarter of a pound per day, and increasing the quantity by degrees to a pound at the end of the next six weeks, at which time the calves are ready to go to grass. After this, the noon meal is discontinued; then, in the course of a week, the morning meal also; and, if there be plenty of grass, the night meal is soon after taken off, too, and the calves entirely weaned at ages varying from twelve to fourteen weeks.

During this time, each calf consumes, on an average, 120 gallons of milk, about 28 pounds of linseed, oat or bean-meal, and as much hay as they choose. Those farmers who are very particular about having their stock brought early to maturity, give their calves nothing but plenty of sweet milk, and a little hay, or oats in the sheaf. This plan is very expensive, and unless followed up by a continued system of high-feeding, so as to have the animals ready at two years old for the butcher, it does not pay. One advantage of using meal along with milk in feeding calves is, that a larger number can be reared, which is important on large arable farms where few cows are kept.

Cheese-making.—A very common mode of managing milk is, to allow it to stand as long in the basins as possible without turning sour, before taking off the cream. The skim-milk is then made into cheese, and the cream put into glazed earthen-ware jars, until as much is collected as will make a proper-sized churning. The process of cheese-making is very simple, compared with the more refined and elaborate methods pursued in the real dairy counties. One-half of the milk to be made into cheese is heated to 120° in a large tin pitcher, immersed nearly to the brim in a boiler of hot water ; it is then added to the cold milk in the cheese-tub ; and if the whole, when mixed, should exceed 90°, it is allowed to cool down to this point before adding the rennet, or "yearning," as it is called ; but, if lower than 90°, a smaller tin pitcher, containing hot water, is immersed in the milk. Half a pint of rennet is employed to coagulate 20 gallons of milk, and the coagulation seldom takes longer than an hour in being completed ; more frequently only half an hour, and sometimes even less. The high temperature of the milk and the strength of the rennet tend to hasten the process much more than in Gloucestershire or Cheshire, where it is a material point to keep the temperature of the milk low, and the rennet just sufficiently strong to effect curdling in an hour or an hour and a half. When the curd is completely formed, the arm is plunged into the mass and the whole gently stirred until the whey separates. A cloth strainer is then placed on the top, pressed down, and the whey removed as it rises through it. When the most of the whey has been got rid of in this way, the tub is tilted to one side, and the remaining free whey allowed to run off, while the curd is retained by the hand, a bit of board, or the skimming-dish. The curd is then put into the wet cloth already used, which is tied at the corners and suspended on a stick placed across the top of the tub. As soon as the whey ceases to drop from the strainer, the curd is salted and put in the cheese-vat, (chessart,) and placed under the press. In six hours, it is taken out, the cheese-vat dried, a clean, dry cloth placed in it, and the cheese which has been pared at the upper edges, inverted, replaced, and returned to the heaviest press, the full weight of which is let down upon it. This generally concludes the first day's work. On the second day, the cheese is turned twice or thrice, and each time inverted in the vat, and a dry cloth used. At the end of the second day, the cheese is taken permanently out of the press, then laid on a dry, airy shelf to ripen, being turned every day and wiped dry with a towel. In many cases, however, skim-milk cheese-making is completed in one day, being only turned twice after the salt is applied ; but, as heavy pressing must be resorted to at the very commencement of the process, when the curd is soft, no insignificant portion of the oily matter is squeezed out. In general, these skim-milk cheeses are very poor, especially if the cream has been allowed to remain long on the milk ; but when well made, they are very palatable, and being mostly pure casein, make excellent nourishing food, along with bread or potatoes, for working people, to whom they are gene-

rally sold by the farmers' wives. Skim-milk cheese is ready for market in two months, and is generally sold at 6 cents per pound.

Whole, or new-milk cheese is seldom made in Fifeshire for sale; but as cheese is never made on Sunday, it is the usual custom to make a larger and better cheese than common on Saturday afternoon. This is made of three or four "milkings"—one or two of the day preceding, and two of that day. The cream is taken off all the milk with the exception of Saturday noon's, which is put in as it comes from the cow. The mode of making this sort of cheese is very similar to that already described; or if there be any difference, it merely consists in bestowing a little more attention in extracting the whey without wasting the oily part, more frequently turning the cheese, and renewing the dry cloths each time. In warm, sultry weather, when the milk will not keep sweet longer than twenty-four hours, or sometimes only twelve hours, it is a common practice to skim it, and then scald it sufficiently in a tin pitcher to form a scum on the surface. This causes it to be kept sweet until as much milk is collected as will make a cheese of the required size. This plan is indispensable in small dairies, in order to get a sufficient quantity of milk to make cheeses of the proper weight. The usual price of sweet-milk cheese is 10 cents to 12½ cents per pound, according to quality; and although very inferior to the rich "Gloucesters" and heavy "Stiltons," it is very palatable, and generally preferred in the rural districts to Gouda cheese, which has frequently a rancid or oily taste. Skim-milk cheeses often become blue-moulded, which is considered a great improvement to the taste. This is caused sometimes by cracks in the cheese, in which the mould-plant vegetates and spreads through the whole mass. Mouldiness is, however, sometimes artificially induced, by pouring Port wine into holes bored in the cheese, and by exposing it to a damp, close atmosphere. If there has been, by any accident, a little sour milk employed in making a cheese, mouldiness is generally the consequence. When sweet-milk cheeses become mouldy, they are considered a great delicacy, being highly stomachic, and an excellent corrective when eaten after fruit.

The weight of cheese which a given quantity of skim-milk will yield, depends greatly on the nature of the land where the cows pasture. On a dry, hilly farm, where the pasture was always one and two years old in white clover and ray-grass, the mean of two trials gave 22 pounds of cheese when newly taken out of the press, from 20 gallons of milk; but, three months afterward, the weight decreased to 18½ pounds. From new milk, the yield of cheese, when three months old, is very nearly a pound to the gallon.

Butter-making.—The manufacture and management of butter form fully as important points in the Fifeshire dairies as the making of cheese. When the weather is cool, the cream is generally taken off the milk when it has stood forty, thirty-four, and twenty-four hours respectively; that is, the produce of the noon's and night's milking two days before, and of the morning's meal of the previous

day, but in warm weather, especially when there is thunder, it is always found necessary to remove the cream every twenty-four hours, to prevent it being curdled along with the milk. In order to have the milk sweet for making good cheese in sultry weather, the cream can seldom be left safely longer than twelve or eighteen hours. The quantity, of course, is very much lessened; but the cheese made from this milk is very superior to the common skim-milk sort, and is quite as good as the so called "sweet-milk" cheeses.

When the cream is removed, it is put into glazed earthen-ware jars, or cans, and allowed to stand until as much is collected as will make a respectably-sized churning. Some farmers' wives churn twice a week, and others only once, the former plan giving the freshest and sweetest butter; and the latter the greatest quantity. In summer, the operation of churning is a very expeditious one, seldom exceeding half an hour. A steady, uniform motion, neither too fast nor to slow, and never intermitted, except to lift the lid of the churn to renew the air, gives the best and finest butter. A rapid motion, especially at the beginning of the operation, causes the cream to heave and swell, from too large a quantity of air being forced into it; and the result is a tedious churning, and soft, badly-colored butter. As soon as the butter comes, the milk is poured off, and the butter put in a shallow wooden tub, of cold, pure spring water, and washed until the washings come away quite pure, and free from milk. It is then ready for being made up for immediate sale, or to be salted. The usual price of butter is from 19 to 22 cents per pound in summer, and in winter from 16 to 20 cents.

In one trial, 100 gallons of milk, in summer, after standing twenty-four hours, gave 5⅘ gallons of cream, which, when churned, produced 27½ pounds of butter, or 14½ quarts of milk to a pound. The refuse of cheese and butter-making, except in the neighborhood of towns, is all consumed at home; the cottars, and other servants not living in the farm-house, generally get as much whey for nothing as they require, the remainder going to the pigs; while the churn-milk and "fleetings" (locally termed "head of whey") are used by the younger members and domestics of the family, along with oat-meal porridge, at breakfast.

Besides the rearing of calves, and the making of butter and cheese in Fifeshire, there are many dairies in the neighborhood of towns, kept solely for the sale of butter and milk.

Feeding.—In summer, the cows are pastured about ten hours daily, upon one or two-year-old clover and ray-grass lea, of which two statute acres are allowed to each animal. When the grass is abundant, which is generally the case during the three summer months, the cows are kept in the pastures every day from 5 A. M. to 8 P. M., and get nothing else except a little "dreg" (refuse of the stills) in tubs placed in the field to drink; but when the grass begins to get hard and more scanty, a plentiful allowance of clover and vetches is given in the house at night, and also a quantity of

"draff" (brewer's or distiller's grain.) When the weather is very hot, and gad-flies are troublesome, the cows are kept in the house during the day, and are fed with clover. They are, however, turned out to the pastures in the cool of the morning and evening.

The quantity of cut grass and vetches consumed by thirty-six cows generally averages about four acres of the former, and an acre and a quarter of the latter, during the season; and in autumn, each cow receives one-third of a bushel of brewer's grains every day.

Winter Feeding.—Winter feeding commences about the middle of October, when the cows are tied up in pairs in the stalls. At 8 A. M. each cow gets bailed food, consisting of 30 pounds of Swedes, $1\frac{1}{4}$ pounds of linseed, 2 pounds of bean or pea-meal, and a quantity of chaff and light grain, unfit for making meal; and a liberal allowance of oat straw is given as soon as this is finished; at 10 A. M. 60 pounds of yellow turnips, and straw afterwards; at 2 P. M. one-sixth of a bushel of grain, value $2\frac{1}{2}$ cents; and lastly, at 5 P. M. 60 pounds of yellow turnips, and oat straw as before. A woman feeds the cows, and is paid at the rate of 16 cents per day, without victuals. The cows are milked thrice a day in summer; at 5 o'clock, A. M., at mid-day, and at 8 P. M. In winter, they are milked only morning and evening; but the newly-calved cows are always milked three times a day. The milking occupies about an hour, one milker to every six or seven cows.

The cows are allowed to run dry about two months before calving; but, in consequence of the high feeding they receive, it is always difficult to get them dry. Mr. Young considers that to attempt to dry the cows, fed in the manner his are, by low diet, has the effect of injuring their constitution. When his cows are to be run dry, he removes them to a separate byre, and gives them straw and turnips, only, but a liberal allowance of both. Boiled or cooked food, he considers injurious to them, when they are not giving milk; but a fortnight before calving, draff is given, and about ten days after that period, feeding is again resumed.

When cows are to be fattened off, the quantity of cooked linseed, bean-meal, and draff is increased, but they are milked as usual, yet, notwithstanding, they are very soon ready for the butcher.

Yield of Milk.—The quantity yielded, on an average, by Mr. Young's cows, is 9 quarts daily for ten months, or 680 gallons annually. The milk is allowed to stand in the basins or coolers from twenty-four to thirty-six hours in summer, according as the weather is hot or cool; after which it is skimmed off, and poured into wooden or glazed earthen-ware vessels, to sour sufficiently for churning. The skim-milk is sent regularly every morning, except Sabbath, to the neighboring villages, where it is sold at the rate of a pint for a cent in summer, and three gills for a cent in winter. The cream is churned twice a week in a barrel-churn, driven by water-power, and the butter sent to market unsalted.

This uniform, high system of feeding, gives results which vary little throughout the year. The greatest decrease of milk, except when the cows are becoming dry, is when they first go to grass, which is exactly the reverse of what happens with those under-fed in winter. The average proportion of milk, cream, and butter to each other, is a gallon of cream to nine of milk, and three pounds of butter to a gallon of cream, or a pound of butter to three gallons of milk as it comes from the cow.

GENERAL REMARKS.

The foregoing remarks will serve sufficiently to exhibit the various modes of managing dairy matters, as at present observed in Great Britain. It will be seen that cleanliness, in every process connected with the management of milk and its products, is of the first importance, and that, without it, neither cheese nor butter-making can be carried on so as to produce an article that will give satisfaction, either to the dairy factor or consumer. No substance more easily receives and retains the odor and taste of putrescent matter than milk; and, from its chemical constitution, it is continually liable to run to acidity and putrescence, when exposed to an atmosphere contaminated with the effluvium of any other substance undergoing the process of decomposition. The practice, too common in many places, of making a larder of a portion of the milk-house cannot be too severely reprehended; and, what is nearly as bad, the more common practice still, of having a number of cheeses undergoing the process of drying on the shelves. It is utterly impossible to keep milk sweet, especially in summer and autumn, where such malpractices are committed; and at any time it cannot be otherwise than productive of the worst effects on the habits of the dairy-maid, whose ideas of cleanliness can scarcely be expected to be very refined under such circumstances. Spilled milk should never be allowed to remain for a single instant longer than is necessary for its removal. The liberal use of water (cold in summer and warm in winter) is always to be commended; and, in rinsing the milk dishes, a little common washing soda, dissolved in the water, will be found highly useful in destroying any taint of sourness they may have acquired, and which, if not removed, is very apt to cause the milk to get sour long before it would do so of its own accord. The best dishes for milk are such as are made either of glass, tin, tinned iron, or well-glazed earthen-ware. Wood, lead, and zinc are all objectionable—the first, on account of the difficulty of keeping the dishes clean; and the two latter, because they are liable to corrosion or decomposition from the action of the acid contained in milk. The more shallow the milk basins are, the quicker will the cream rise, and the greater will be the quantity. In summer, small basins are preferable, as they allow the milk to cool more quickly to the proper temperature; and in winter, large tin cisterns may be advantageously used, as the milk is longer cooling down to

that point at which the cream ceases to rise readily. All milk-houses should have a northern aspect, and be well protected from the rays of the sun. A thorough draught near the ceiling, which can be controlled at will, is essential to keep the atmosphere always fresh. A stone table, slabs of stone, should occupy the centre of the milk-house, for the basins to stand on, so that the fresh air may surround them equally, which can never be the case when the basins are placed in nooks and corners, or along the sides of the walls. The table should be water-tight, and furnished also with a water-tight ledging, so that cold or warm water may be thrown around the milk basins when required. Finally, on this head, we may say that no food, either vegetable or animal, should be allowed to enter the milk-house, nor even the cream-jars be admitted. A good mode of purifying the atmosphere of a milk-house is, to dip cloths in a solution of chloride of lime, and then hang them up on cords stretched from one corner to the other. In a similar way, too, the temperature of the room may be kept low during the hot weather. Cotton blinds, kept moist, in front of open windows, are used in India as means of cooling the air of sitting rooms, and they might be easily introduced for the humbler purpose of cooling the air of the dairy, or milk-room.

For removing from the milk the taste of the food on which the cows are fed, which, in the case of turnips or cabbages, is often very strong, several recipes have been given: To stir the milk for some time after it is drawn; to place it in vessels which have been washed with a dilute solution of saltpetre, and in which a little of the saltpetre may remain; or, to add to every two gallons of milk, as it is drawn, a dessert-spoonful of a solution of nitre; and to add to every gallon a table-spoonful of the clear solution of half an ounce of chloride of lime in a gallon of water, have all been suggested. To feed the cows with the turnips immediately after milking, so that twelve hours elapse, in which the aroma may be got rid of in the animal itself, is also a plan recommended by some.

Management of Dairy Cows.—The feeding of cows is a very important point in dairy management. Regularity in feeding is indispensable; so much so, that cases might easily be adduced to prove, that a greater quantity of milk is obtained by attention to this point, than with higher feeding not accompanied by this simple precaution. Experienced dairymen give it as their opinion, that any irregularity in the times of giving cows their food, is invariably followed by a marked diminution in the quantity of milk yielded, and that this continues for some time, even after regularity has been resumed.

Without a steady adherence to the three great requisites—regular times of giving cows their food, gentle treatment, and uninterrupted high feeding while in full milk, it is very questionable if a dairy can be made to yield a profit.

In the English dairy counties, cows are miserably lodged and as badly fed in winter. Some change for the better is desirable in this respect; and the first and most obvious is, the conversion

of a considerable portion of land from permanent grass into cultivation. That landlord ill consults his own interests, who countenances a system under which improvement is well nigh impossible; and where the land is permitted to continue of one unvarying value from year to year, except so far as the character of the seasons may increase or diminish the quantity of its produce. The mixed arable and dairy system, detailed in several sections of this article, as practised in Scotland, is greatly to be preferred to that pursued in many of the English counties. The dairy is as profitable of itself in Scotland as it is in England, while, at the same time, the farmer is not entirely dependent on it for paying his rent; it forms, in fact, only a part of a system which contributes its share to the general fund; whereas, in Gloucestershire and Cheshire, the principal dependence of the farmer is upon the produce of his cows.

Where dairies are kept solely for the sale of milk, a uniform system of high feeding is indispensable. Cooked linseed, bean-meal, and distiller's grain, appear to be the great auxiliaries which he has recourse to in order to sustain his cows in full milk; and not only does this high feeding afford a clear and undeniable profit, but it also furnishes a large supply of rich manure, which goes to increase the fertility of his farm.

Breed of Cows.—For purely dairy purposes, the Ayrshire cow deserves the first place. In consequence of her small, symmetrical, and compact body, combined with a chest rather narrow than otherwise, and a capacious stomach, there is little waste, comparatively speaking, through the respiratory system; while, at the same time, there is very complete assimilation of the food, and thus she converts a large proportion of her food into milk. So remarkable is this fact, that all dairy farmers, who have any experience on this point, agree in stating, that an Ayrshire cow generally gives a larger return of milk for the food consumed, than one of any other breed. The absolute quantity may not be so great, but it is obtained at a less cost; and this is the point upon which the question of profit depends.

The Jersey cow is remarkable for the richness of her milk; so much so, that two or three of this breed, kept in large dairies, very perceptibly improve the quality of the butter and cheese.

Shorthorned cows are seldom good milkers, unless the climate and food are both very favorable, and, under most circumstances, they have a greater tendency to produce fat than milk. Mr. Harley tried them at the Willowbank dairy, but he found that they were far less profitable thar the Ayrshire breed. The shorthorned cows gave as much milk as he Ayrshire, but they consumed considerably more food. For mixed arable and dairy-farming, where young stock are reared, the most profitable in Scotland have been the Ayrshire, Fifeshire, and Angus breeds; or, a first cross of one or other with the Shorthorns, or an animal of some second-rate breed, is usually preferred for dairy purposes. In Ireland, the small Kerry cow is invaluable, and is, in fact, the only *native* breed worth preserving and improving for the sake of its milk-producing qualities. D. J. B.

THE QUADRUPEDS OF ILLINOIS

INJURIOUS AND BENEFICIAL TO THE FARMER.

BY ROBERT KENNICOTT, OF WEST NORTHFIELD.

However injurious wild animals may be to man, he should not forget that he himself is very often the cause of their undue destructiveness. When destroying his crops, they are only following the instincts with which they have been endowed by the Creator. Ruled by All-wise laws, every animal fills its appointed place exactly, existing not alone for itself, but forming a necessary part of the vast system of Nature. One class of animals keep in check certain plants; others prevent the too great increase of these, while those having few enemies are not prolific. Man interferes unwisely, and the order is broken. It is true that, to some extent, an interference with the natural regulations of the animal creation is necessary to the progress of civilization. Man appropriates to himself the food of many animals, but as they continue to devour this wherever found, he must therefore sometimes destroy them or lose his property.

But, before waging war upon any animal, let us study its habits, and look well to the consequences which would follow its extermination. We must remember that it is an undeniable fact, that the dangerous increase of any species is due to the destruction of its natural enemies; and, indeed, would we stop the ravages of a vegetable-eating animal, the easiest and most certain way generally is to encourage the increase of these enemies.

But some men think animals unworthy of study, and do not know the injurious from the beneficial. A farmer's poultry have been killed by some carnivorous mammals or birds, and he therefore destroys every one of these, large or small, indiscriminately, whether found about his farm-yard or out in the fields. Some birds injure his crops, and so every bird that ever ate a grain of corn is shot, while many, which are not known to do any harm, are killed lest they should; and his boys are hence encouraged to destroy blackbirds' nests, and they very naturally extend their destructiveness to every other bird's nest they can find. The meadow-mice are injurious, and he accordingly wages war upon the shrews and moles, which he confounds with the mice, or accuses of performing their work. He knows some snakes are venomous, and so pronounces all reptiles "deadly" and "horrible things," to be dreaded and destroyed. His crops are affected by insects, and he eagerly kills the carnivorous species with the others. And then the gnawing mammals kill his trees and destroy his crops, and the insects multiply alarmingly, and he wonders "why such worse than useless creatures were created!"

A more careful study of animals would surely benefit our farmers. I would earnestly commend the subject to their special consideration. If they say they cannot spare time to watch the habits of animals, then let them encourage their children to do so, not alone that they may endeavor to learn, for practical purposes, the injurious from the beneficial, but also because of the good influence produced on mind and morals by the study of Nature—a study which will become the source of much profit and pleasure, as soon as the observer once begins earnestly to investigate Nature's truths; and the interest will increase in proportion to the knowledge gained. Every farmer's son and daughter should be naturalists; they have the best of opportunities for it. A few minutes spent at the right time would often reveal to them facts which naturalists have labored days in vain to discover. Workmen in the field have frequently passing under their eyes things which the naturalist would travel miles to see; and they daily and hourly witness things it would profit them much to observe. A farmer eagerly kills a harmless snake, and thinks he has done well. But it is not so. Let him examine its mouth, and he will find no poison fangs there; and if he opens its stomach, it will be found to contain only insects, or, perhaps, meadow-mice. It takes but a moment to observe these things, yet, if he uses well the knowledge gained in this moment, it may prove to him of great value.

Farmers must not suppose that, in order to study animals profitably, they are obliged first to read scientific books. These are of much importance, but not all that is to be observed. A knowledge of the scientific names of species is of great value, enabling any one to learn the habits of animals not well known from others, or from books, and to communicate facts observed by himself, while the imperative necessity for a system of scientific names in any extended study of natural history is too apparent to need comment. Common names may be used locally in conversation, or written, for want of better; but numerous misapplications and errors are sure to result. Farmers may be—and, to their credit be it said, many are—well acquainted with the habits of the animals about them, even though they know nothing of scientific names. These, however, by careful observation, have learned to distinguish certainly and readily each animal, and are not likely to consider moles, shrews, and meadow-mice as one and the same.

Let any farmer spend a few leisure half hours in observing the habits of animals, and then ask himself if the time thus spent has been wasted. True, he may not always have been in any way pecuniarily benefitted; but many men now-a-days realize a desire for knowledge whether that knowledge brings direct pecuniary profit or not; and while years spent in studying the words of dead languages, the fine arts, and man's various creations, are taught to be profitably used, might it not be well to devote a few hours to the study of God's language and fine arts, that their beauties too may be appreciated and understood?

SQUIRRELS.

The true squirrel is arboreal. His home is in the trees, and his legitimate food their fruits and buds. Should he go to the ground, it is only in search of food; and, this obtained, he returns to his airy dwelling-place. Here, in summer, he builds him a nest of leaves taken from the branches at hand; and in a hole in the same tree, or in one that he can attain by springing from branch to branch without going to the ground, he has a more secure retreat, to which he can retire during inclement weather, or escape the attacks of an enemy, and in which the young are generally reared.

This class of squirrels possesses a muscular but light and graceful form, with the toes long and the nails strong and sharp, by which they are enabled to climb trees and take long leaps among the branches with wonderful ease. In these leaps, they are also aided by their large and bushy tails, which serve as rudders to steer by. They use their fore-feet as hands, seizing their food with them, and stand upon their hind-feet, when eating. On the ground, they either run or move by springs made mainly by the hind-legs. Unlike most of the order, they move about by day and keep in their retreats at night, to which they also retire for a few hours during the middle of the day. Though their food is properly vegetable, squirrels are known to eat insects. By a slighter departure from their natural food, they exhibit a fondness for corn, and more rarely wheat and other grains, which is highly prejudicial to their good standing in a community of farmers. In fact, these animals are frequently much more injurious than is generally known. In certain districts, whole fields of corn are destroyed by them at times, while it is a common thing to find considerable tracts lying near the woods not worth harvesting, because of their depredations. So serious was the result of their ravages at one time in the Eastern States that, as related by Pennant, in the year 1749, £8,000 were paid out of the treasury of Pennsylvania in premiums for the destruction of squirrels. The premium for each being 3*d.*, would show that the enormous number of six hundred and forty thousand were killed in one year, besides the vast numbers for which no rewards were claimed, and those also which were otherwise destroyed.

In some States, parties for grand hunts are occasionally organized in autumn, the hunters forming into two companies, each of which endeavors to outdo the other in the number of squirrels brought in, and the losing party forfeiting the expense of the evening's entertainment at the wayside or village inn. These hunts are kept up from one to three days, and the quantities of squirrels sometimes shot—without estimating those purchased for the occasion by eager but unfair members of the company—would seem incredible to persons not residing in localities where they abound.

Squirrels at times form a valuable addition to our food. There is a foolish prejudice existing among many against eating them; but a

young spuirrel properly cooked makes a delicious morsel, and old ones are far from unpalatable, when fat. Their flesh is certainly more healthful and delicate than that of so unclean an animal as the hog, which, nevertheless frequently is preferred. Great numbers are sold in our city markets, and usually at low prices. In winter, thousands of migratory Carolina and fox-spuirrels are bought up by purchasers of provisions throughout Indiana, Michigan, and Illinois, and forwarded to Chicago, where the marketmen retail them at 12½ cents each. The skins of our American species are of no value in commerce, their fur being little esteemed and seldom used.

Squirrels probably do not suffer much from the attacks of wild animals. Man is their worst enemy. Wild-cats, martins, and some of the larger hawks and snakes sometimes capture the young, and more rarely the old ones. They are occasionally invested by the larvæ of a species of œstrus, which must give them much annoyance. These grubs, or "warbles," are found living in the skin, in abscesses formed by their presence, usually about the shoulders and such other parts as the squirrel cannot reach with his teeth.

Squirrels are readily domesticated, making pleasing and inteligent pets. In confinement, they exhibit their usual activity; and, indeed, if not permited exercise, they often pine and die. Cages are hence usually provided with revolving wheels, in which the captives soon learn to turn, and from which they derive even more enjoyment than do the spectators by this substitute for their natural exercise.

LARGE-TAILED FOX-SQUIRREL.

[PLATE V.]

Sciurus magnicaudatus, Harlan.
Sciurus macrourus, Say and Godman.
Sciurus sayi, and *S. rubricaudatus*, Audubon and Bachman.

Description.—Form of large female in winter much stouter and heavier than that of the Sciurus migratorius; length from snout to root of tail, 12 inches; tail, (vertebræ,) 10½ inches; tail to end of longest hair, 14 inches; hind-foot from heel to longest toe, 3 inches; breadth of head between the ears, 1¾ inches; girth behind the shoulders, 7 inches; weight, 2 pounds and 2 ounces; breadth across the tail, with the hairs in their natural position, as in life, 6 inches. The outside of the ear is clothed with long hairs, which extend over three-eighths of an inch beyond the tip. The rudimental thumb of the fore-foot is protected by a flat, blunt nail. In this, as in other winter specimens of this species, the coat of fur is remarkably thick and warm.

The general color of the fox-squirrel is mixed, grey and black above, and reddish-yellow below; the hairs on the back are bluish-black at the base, broadly ringed with brown, more narrowly with

black, then with greyish-white, and slightly tipped with black; a few hairs extend beyond the rest, the extra length of these being entirely black. The hairs on the top of the tail have three black and three light-brown rings alternately, broadly tipped with reddish-yellow. On the sides and tip of the tail, the hairs are for two-thirds of their length reddish-yellow, then ringed once more with black, and broadly tipped with darker reddish-yellow; on the under surface of the tail, the hairs are entirely of a bright reddish-yellow. Thus the under side of the tail is of a deep reddish-yellow, surrounded by a distinct subterminal band of black, beyond which it is edged with the color of the centre; the upper surface of the tail is mixed, brown and black, beautifully edged with a terminal band of reddish-yellow. The cheeks, upper lips, the space around the eyes, ears, feet, and entire under parts of the body and legs are of a rich reddish-yellow. The hairs on the belly are ashen for a short distance at the base. The whiskers are entirely black. The toes and soles of the feet are also black; nails black, tipped with white; incisors deep reddish-orange. One remarkable feature in this species is that the bones are tinged with red. Summer specimens are of lighter colors, with the hair much thinner and shorter, and without the thick coat of long hair on the posterior surface of the ear.

With one exception, I have seen no distinct varieties of color in this species. In some specimens, at different seasons, the color of the under parts, however, grades from light-yellow to deep reddish-orange; and a summer specimen, obtained in Missouri by Dr. P. R. Hoy, of Racine, Wisconsin, has the under parts of a dark-rufous cast. This specimen is also blacker than usual on the back, and comes nearer to Audubon and Bachman's figure of S. sayi than any other I have seen. This and other specimens of the two extremes of coloring in other respects are alike.

A variety of this species is occasionally met with in which the tail and upper parts are of the usual colors, but with the entire under parts of the body perfectly black. It has only been observed in Southern Wisconsin and Northern Illinois.

I have thus minutely described this squirrel, because Audubon and Bachman have, in their "Quadrupeds of North America," made two species of it. It is undoubtedly the S. magnicaudatus, of Harlan, first described by Say, who unfortunately gave it a name already belonging to another squirrel. Under the name of S. sayi, Audubon and Bachman have described a specimen of this species, of unusually bright colors, their highly-colored figure exaggerating the hue of the under parts to a bright orange-red, or ferruginous. This they give as the "Great-tailed Squirrel" of Say, Godman, and Harlan, and as being an abundant species in Illinois. But, among hundreds of specimens both from Northern and Southern Illinois, as well as from Michigan, Indiana, and Wisconsin, examined in the Chicago markets and elsewhere, I never saw one corresponding fully to the figure and description of S. sayi given by the authors named above. The figure and description of their

S. rubricaudatus, were taken from a young specimen of this species in summer pelage of rather light color.

In its home at the West, this large and beautiful species is universally known under the name of the "Fox-squirrel," and, though other American species are also called by this name, it would be useless now to attempt to apply any other. This squirrel has been observed throughout Illinois, in Southern Wisconsin, Eastern Iowa, Southern Michigan, Western Indiana, and, according to Dr. Hoy, throughout the northern part of Missouri, as far south as the Osage River, at least, and in Eastern Kansas. I have also seen it from Western Kentucky, where I am informed it abounds, as well as in Southeastern Missouri, and it will probably be found in other States further to the south and west. Captain Marcy saw a species he supposed to be the S. magnicaudatus as far south as the Red River of Louisiana. In Northern Michigan, Northern Wisconsin, Northern Iowa, and in Minnesota, I am informed it does not exist, and its northern limit appears to be between the forty-third and forty-fifth parallels of north latitude, though further north it is said to be found in Eastern Michigan. Several specimens of this species have been seen in Ohio, but their appearance is explained by the fact that several individuals taken in Wisconsin, are known to have been liberated in the same locality, some time before. It is very abundant throughout Illinois, where, in some localities, it exists in greater numbers than any other species.

The fox-squirrel loves neither low lands nor deep woods; and, though found living in the heavily-timbered districts of Indiana and Illinois, it is less at home in these than in more open ground. It is properly an inhabitant of the timber of the prairie regions, and its favorite habitat is in the "oak openings" of Wisconsin and Michigan, and the groves or edges of the belts of timber that skirt the streams watering the prairies of Illinois. Since these river belts and the prairie groves, or "Islands," as the old settlers appropriately termed them, have been protected from the fires that formerly swept them annually, many young trees, especially pin-oak. (*Quercus palustris,*) in Northern Illinois, have sprung up around them at the edges of the prairie, forming ornamental clumps, that are useful as protection against the sharp prairie winds—the more so as the pin-oak retains its leaves during winter. These are favorite haunts of the fox-squirrel, and whenever a hollow tree of larger size stands in one of these outlaying groves, it will be the home of a pair. In some localities in Northern Illinois, many young pin-oaks are destroyed by having the bark stripped from the trunks and larger branches, which kills the tops. As neither the porcupine nor any other bark-eating mammal which can climb, is found here, and as this squirrel is known to frequent these young pin-oaks, the guilt has been charged upon him without further evidence than this. It is only within a few years that this extensive destruction of the young oaks has been observed in this vicinity, and it is yearly increasing, while the fox-squirrels are now less numerous than formerly, and food is more abundant, as hogs do not now consume the

mast as they did several years ago. Though the tops of hundreds of trees have thus been killed, I have observed none gnawed in neighboring woods where the fox-squirrels are equally numerous.

If this bark-gnawing increases and becomes general in this vicinity, it will be a source of much damage, as the blighted tops of the injured trees would sadly disfigure our beautiful prairie islands in summer. To eat bark, would be a departure from the natural habits of this animal, and, before the guilt of being the author of this mischief can be justly fixed upon him, better proof must be produced. It is not impossible that some bark-gnawing rodent, hitherto unnoticed, may exist here.

But the fox-squirrel is also charged with thieving from the corn-field; and this accusation is supported by unimpeachable evidence. More corn is destroyed by this species than is usually supposed, the mischief being, without investigation, very generally charged upon the raccoons. But any of our farmers, whose corn-fields are situated in or adjoining to timber, inhabited by it, will find that, while the corn is in the milk, many ears are opened, and, if not eaten, much injured, or destroyed, by exposure to the weather. The small-sized marks of the squirrel's cutting teeth in the husks, instead of those made by the raccoon's widely-separated canines, and the fact that the corn is not torn down as it would be by a heavy animal, will sufficiently prove to him that it is not the raccoon, alone, which does the mischief. And, if he will watch carefully some day in his corn-field, he will detect more than one red bushy tail, whisked incessantly up and down, as its owner, clinging to a corn-stalk, makes a delicious meal of the milky grains. Not only does he thus eat the corn on the stalk, but he gnaws off whole ears, which are never eaten on the ground, but always carried to the fence, or to a neighboring tree, where, perched upon a flat rail or large limb, he discusses them at his leisure. Sitting upon his hind-feet, he tears off the husk and pulls out the kernels with his teeth ; and, if the corn is in the milk, all the soft part is eaten, but, when ripened, he often lays down the ear, and, holding the kernels in his paws, only gnaws out the germ. Along fences, or under trees, situated in or near corn-fields thus attacked by squirrels, husks, cobs, and partly-eaten ears of corn may frequently be found. Sometimes, when squirrels are molested, they do not stay near the field to eat the corn, but carry the ears off to some distance in the woods. I am informed that when the crop of mast is scanty, large corn-fields have been destroyed in parts of Illinois and Indiana by this, and one or the other of the two species next to be described ; while fields in these localities are more or less injured every year, especially if bordered by timber, or with a few old trees standing in them, in which the squirrels can take refuge, as they venture with less fear into these fields than into those at a distance from their congenial refuge. I have observed, however, that the fox-squirrel will leave the immediate vicinity of trees more readily than the other species. Like other squirrels, it will run along a fence to a much greater distance from the woods than it will travel on the ground ; and, when in the

woods, it will always run upon a log in preference to keeping upon the ground.

This, as well as several other true squirrels, will sometimes, though rarely, dig up newly-planted corn ; and at times it devours wheat and also other grain. But, usually, the only considerable injury it does the farmer is in the destruction of corn in the ear.

In the woods, the food of the fox-squirrel consists almost entirely of the nuts and seeds of trees, with the buds of some species, including bass-wood, elm, and maple. In autumn, it eats the fruit of various thorns (cratægus); various berries are also eaten by it, and it is said to be particularly fond of strawberries. In common with other squirrels, it sometimes eats insects ; and it has occasionally been observed to gnaw the bark from dead trees, to procure beetles and their larvæ. Like other squirrels, too, it has been seen to gnaw through the bark of trees girdled in spring, to taste the decomposing sap. So fond of this is it that fifteen or twenty grey-squirrels have been seen thus engaged upon a single oak, thus girdled.

It is a common opinion that this and other squirrels carry large hoards of nuts to hollow trees for consumption in winter. So far as our three species, common in Illinois, are concerned, this is entirely erroneous. With the exception of the little "Chickaree," no true squirrel that I have observed ever collects food for winter in hollow trees. A few nut-shells are sometimes found in a squirrel's hole, but these are only such as he has taken there to be eaten at the time. The fox-squirrel, with the migratory and Carolina squirrels, also, as well as others probably, buries large quantities of nuts and acorns under the leaves in autumn, for use in winter. These, however, are not collected together, but concealed one in a place. In winter, the squirrels dig them up ; and, when the ground is covered with snow, numerous holes will be seen where they have dug down to get them. It is interesting to notice that they seldom dig through the snow and leaves in this way without coming directly upon the buried nut or acorn, and a common idea is that the animal "remembers" the spot. This is highly improbable. It is more reasonable to suppose that the animal is guided by the sense of smell. Dr. Hoy tells me that he has seen squirrels run about with the nose close to the snow or leaves, and finally dig directly upon a buried nut without hesitation. He gives it as his opinion that they can always smell the food, unless it is buried under very deep snow. I am not aware that corn is thus stored for winter use. Though many nuts and acorns are buried in this way, the fox-squirrel, as observed in Northern Illinois, at least, does not depend much upon them for food, when the snow is deep, at which time it feeds chiefly upon buds, searching carefully, also, for the few nuts, acorns, and seeds which may have remained upon the trees, and for the dry berries of the Celastrus scandens, and other vines or shrubs.

Mr. Smiley Shepherd, of Hennepin, Illinois, in a letter containing reliable account of the mammals of his region, informs me that he has repeatedly observed where the fox-squirrels have carried large numbers of nuts and deposited them securely in the forks of

small trees, their tracks being readily traced in the snow to where the nuts had been recently dug out. This was observed in cold weather, when the snow was deep. Unless Mr. Shepherd mistook the work of wood-peckers and nut-hatches for that of squirrels—which is hardly probable—this is an interesting fact with regard to the habits of this squirrel.

I have observed that, in digging nuts from under the leaves, in winter, the fox-squirrel never remains upon the ground to eat them, but carries them to a neighboring stump or log, or, more frequently, to the low branches of some small tree, under which the shells are found cut and broken into a number of pieces, instead of having small linear openings cut through the thinnest part of the shell.

The fox-squirrel is more solitary in its habits than the migratory squirrel. More than two old ones are rarely, if ever, found living together. In the summer and fall, the old males lead a solitary life, as they sometimes do in winter. As soon as the young are able to take care of themselves, the female usually drives them off, when the old male, which has retired to a summer residence to escape the discomfort attendant upon the rearing of a family, returns to the winter-quarters and society of his chosen mate; for, usually, this species is not polygamous. This squirrel often, if not generally, builds several nests, each of which is sometimes a simple pile of twigs and leaves placed in the forks of a tree, but at other times is carefully and ingeniously constructed, being round, with the central cavity quite roofed over, and a small entrance on one side. The more carefully-formed nests are usually on tall trees; but temporary habitations are frequently built on small trees, and within 20 feet of the ground. After being driven off by the mother, the young usually separate and lead a wandering life, for a time, at least. They build nests wherever they stop, even for a day or two; and I have several times observed individuals to appear in a grove of young oaks, build a nest, remain a few days, and then disappear, perhaps to return again in a week and build other nests.

The fox-squirrel loves to take up his abode in a hollow tree which stands out alone at a little distance from the surrounding timber, as if desirous of having a clear view of all going on around him. When he once becomes domiciled in a tree, he does not leave it, unless disturbed, pairs being observed to inhabit the same tree for five or six successive years. It is less prolific than either the migratory or Carolina squirrel. From two to four young are usually brought forth at a birth, the most common number being three; but in one instance, I have seen five. Two litters are probably produced each season. So far as has been observed, they are always brought forth in the hole, the nests of leaves being only used as summer-houses. Like the young of most rodents, they are ugly, unsymmetrical little beings, at first, with monstrous heads and closed eyes; and it is some time before they acquire the elegant proportions and agile movements of their parents.

These squirrels sometimes leave their holes for food, and even for amusement, in very cold and rainy weather, when they are found

moving about much more than the migratory species. But, though active at this time and apparently engaged in play, they do not now "bark," as on warm and pleasant days. Like other squirrels, they dislike to move about in windy weather, when the waving branches make their highways among the tree-tops insecure.

The old comparison, "As lively as a squirrel," is not inapt, and the fox-squirrel, like the other, exhibits remarkably active habits. While the females and young are together, in early autumn, it is amusing to watch the movements of a party on any pleasant day, when their enjoyment of the abundant food and things in general is testified by a degree of sprightliness and agility quite astonishing. One afternoon, in September, by concealing myself near a large hickory on which four or five were engaged in eating unripe nuts, I had an opportunity of witnessing their movements without alarming them. With surprising ease, one would run out upon a limb so slender that it would bend beneath his weight, and, seizing a nut in his teeth, he would pull it off and carry it back to a more secure seat on a large branch, always returning to the same spot. Here, standing upon his hind-feet in a posture nearly erect, and holding the nut in his fore-paws, he first gnawed off the outer covering, and then cut open the shell and devoured the kernel rapidly. Sometimes, in attempting to pick a nut, one would drop it, when he would invariably stop, turn his head on one side, and, with a provokingly comical expression, watch its descent. They seldom remained quiet for a minute at a time. If not eating, they would scamper up and down, sometimes springing from limb to limb, with no other apparent object than fun. Their long bushy tails were never kept still, but continually jerked up and down. Occasionally, one would stop for an instant, and utter a short bark, or chatter. One kept aloof from the rest, and when approached by any of them in their play, chased them off with an angry guttural snarl. A movement at length discovering me to them, some scampered further up the tree, while one, after watching my partly-concealed form a moment, ran down the trunk to within 20 feet of the ground, and, spreading himself out flat against the tree, with his head down and tail extended straight behind him, barked at me with energy. He first uttered several abrupt notes, *quak-quak*—and then a long shrill *qua'a-a-a*, the number of the short sounds varying, but always followed by the long sharp *qua'a-a-a*. At the repetition of each short note, he jerked his body violently, and whisked up his tail slightly, giving it a gracefully undulating motion. He continued to bark thus incessantly for several minutes, until, at length, I exposed myself fully to view, when he hastened to the opposite side of the tree, and ran to the top, uttering a low chatter of affright.

This species is usually more silent than the migratory squirrel; and, if one of them hears any loud noise in the woods, it hides or runs to its hole, instead of chattering at it, as the other often will; though, while at work in a field near the summer home of an old male, I have many a day been cheered by his merry *quak-quak-qua'-a-a-a*, uttered for an hour at a time.

To use the words of the hunters, fox-squirrels "hole" more than the migratory squirrels; that is, they keep more in holes, spending less time in their nests of leaves, to which, however, they are fond of retiring on sunny days late in autumn. At this time, I have seen lazy hunters go about firing into the nests with shot guns, calculating that the proportion containing squirrels would compensate for the waste of ammunition fired at empty nests.

I am not aware that this species has ever been known to migrate in large companies, though some will occasionally move from place to place singly, in search of food, as will the Carolina squirrel and several others, besides the migratory squirrel. Several instances are on record of a fox-squirrel crossing a prairie in summer four or five miles in width, to reach timber upon the other side.

This species, as if from living in more open woods, runs better upon the ground than others. They venture a considerable distance from their home, but when chased, they will even, if hard pressed, run a long way upon the ground in the endeavor to reach their hole, rather than take to the first tree, like other squirrels. The tree attained, they never stop upon its branches, but run directly into the hole. In the woods, this squirrel is usually more shy than any others that I have observed; at least, it will not expose itself as boldly to any one seen by it. Yet it takes up its abode near dwellings much oftener than the others; indeed, I know of no squirrel, excepting perhaps the chickaree, that will live as near the habitations of man as this. I have observed several instances in which pairs of fox-squirrels have lived and reared young, for a number of years, in trees situated within a few rods of dwelling-houses; and, in winter, I have seen these, as well as others from the woods, come boldly about the farm-yard or corn-crib in search of food.

For a figure of the fox-squirrel, (*S. cinereus*,) of Pennsylvania, see Plate v.

MIGRATORY, OR COMMON GREY AND BLACK-SQUIRREL

[PLATE VI.]

Sciurus migratorius, AUDUBON and BACHMAN.

DESCRIPTION.—The adult male measures about 12 inches from the nose to the root of the tail; vertebræ of the tail, 10½ inches. In color, there are two very different varieties of this species commonly met with. One is of a blackish-brown on the upper parts, lighter beneath, and with some rusty markings on the feet and face. The other is of a grey color, with reddish-yellow markings about the head, belly, sides, and feet. These two varieties are commonly considered among our farmers, as distinct species, and are respectively called the "grey" and "black" squirrel; but any one living in the woods may, by a little observation, satisfy himself of their identity as one species,

and the females will be found to bring forth specimens of both varieties at one birth, and the two live and breed together without regard to color. They are now known under the two very different names of the "black" and the "grey" squirrel; but while there are other black and grey-squirrels, would it not be better for our farmers to adopt the highly appropriate name of the "migratory squirrel" for this species — the more so as Audubon and Bachman have, with good taste, given this as its specific name?

The grey-squirrel is the most abundant, and, it is said, sometimes exists in great numbers where none of the black ones are found. The black variety, however, is sometimes, though rarely, the most numerous in certain localities. In a lot of nearly fifty, shot near the Rock River in Illinois, there was not a single grey one, all being of the black variety.

In the Northern States, the migratory squirrel replaces the Sciurus carolinensis, of the South. It exists throughout the Eastern, Middle and in some of the Western States, and is said by Audubon and Bachman to be found as far north as Hudson's Bay. In Illinois, it exists only in the northern part of the State, being replaced by the Carolina grey-squirrel in the South. It exists abundantly in Northern Illinois, Southern Wisconsin, and Central Iowa, but to the northward, I am informed by Dr. Spear B. Davis, of Shakapee, Scott county, Minnesota, that it is not observed in the southeastern portion of that Territory. I learn from Dr. Hoy that it does not exist in Northern Wisconsin. Audubon and Bachman, however, mention its being found on the Upper Missouri.

This is the most abundant of our American squirrels. It has a wide geographical range, and is prolific, and in many localities exists in almost incredible abundance. The immense numbers, heretofore mentioned as killed in one year for the bounty offered by Pennsylvania, were chiefly of this species. In Northern Ohio, I have seen them in such numbers as to be truly astonishing. Dr. Hoy relates that he knew a hunter in that State to kill one hundred and sixty in a day, and that, too, when they were not unusually abundant in the locality. In parts of Michigan, Illinois, Southern Wisconsin, and Indiana, they are no less numerous. Existing in such myriads, their depredations, of course, become at times a source of serious damage to the farmer. Fields of corn, and occasionally wheat, are much injured or entirely destroyed by them. I am informed that persons have sometimes kept watch in their fields to drive them off, and thus prevent the destruction of the whole crop. This species appears to increase in numbers, in certain districts, for a time after their settlement.

The migratory squirrel is at home both in low, heavy timber, and higher and somewhat more open woods, though it loves the heavily-timbered, elevated ground best. It never frequents the outskirts of the woods, of which the fox-squirrel is so fond, and does not affect oak openings, nor the prairie groves, unless well timbered. This is one of the most active of our squirrels, and, when out in fine weather, and not engaged in feeding, may be seen scampering about the trees, as if much exercise were necessary to its existence. It leaves the

trees unwillingly, and in its progress, travels as much as possible upon fallen logs in the woods, and on fences in the fields. It does not run readily upon the ground, and, when pursued, if possible, soon takes to a tree.

The most interesting feature in the habits of this animal is the remarkable migration performed at times by large bodies of them. I am not aware that any of these extensive migrations have been observed in Northern Illinois, but in the neighboring states of Wisconsin and Michigan, and in other localities where the species abounds, they not uncommonly occur. Immense numbers congregate in autumn, and move off together, continuing their progress in the same general direction, whatever it may be, not even turning aside for large streams. Ordinarily averse to entering the water, they now take to it boldly, and, though swimming with difficulty, manage to cross broad rivers, like the Niagara and the Ohio, though many are drowned in the attempt. The vulgar notion that squirrels, in crossing water, "are ferried over on bits of wood and bark, using their tails for sails," is, it is, perhaps, needless to say, entirely fabulous. Sometimes, when on these migrations, especially after crossing rivers, the squirrels become so fatigued as to be easily captured, and thousands are then killed by boys armed merely with sticks and stones. I learn from Dr. John A. Kennicott that, during one of these migrations, innumerable squirrels swam across the river Niagara, and landed near Buffalo, New York, in such a state of exhaustion that the boys caught them in their hands, or knocked them from the fences and bushes with poles. It must not be supposed, however, that the squirrels, in these migrations, rush ahead without stopping, or turning to the right or left for food. Better would it be for some unhappy farmers if such were the case, for ill fare the corn-fields which they visit. Generally, they are observed to make their appearance in unusual abundance, running along the fences, and up every tree; and, though they may often go out of their way to follow a fence, or to enter the woods, in preference to crossing open ground, or even to stay some time in one locality, they are always tending forward more or less rapidly in one direction.

The reason for these migrations is not satisfactorily explained. That they are caused by want of food is hardly probable, as the squirrels are found to be fat at the time, and as often leave localities abounding with food as otherwise. After one of these grand migrations, very few of the species are found in the localities from which they have moved, and these, as if alarmed at the unusual solitude, are silent and shy. They rapidly increase in numbers, however, and, in a few years, are as abundant as before. I am not aware that they ever migrate except when exceedingly abundant. Of these immense hordes, but few probably survive. No sudden increase in their numbers was heard of in Southern Wisconsin after the several migrations from Northern Illinois. Many are drowned in attempting to cross streams as has been stated; not a few are destroyed by man; some die from utter exhaustion; and, when thus forced to travel, in an unnatural manner, upon the ground, they fall an easy prey to

rapacious birds and mammals, all of which feast when the squirrels migrate. I learn from Dr. Hoy, that one of these migrations is said to have taken place in Southern Wisconsin in 1842; he witnessed another in 1847, and a third in 1852. From these facts, and from observations made in Ohio and elsewhere, he is of the opinion that the migrations, in most cases, at least, occur at intervals of five years; and, if he be right, the squirrels, which are now exceedingly abundant again in Southern Wisconsin, may be expected to migrate in the autumn of 1857. He further says, that the migrations observed by him, in Southern Wisconsin, occurred when the mast was exceedingly abundant and the squirrels in excellent condition. Near Racine, they were observed passing southward in very large numbers for about two weeks, at the end of September and the beginning of October; and it was a month before all had passed. They moved along rather leisurely, stopping to feed in the fields, and upon the abundant nuts and acorns of the forests. So far had they departed from their accustomed habits that they were seen on the prairie, four or five miles from any timber; but even there, as usual, they disliked to travel on the ground, and ran along the fences wherever it was possible.

The food of these squirrels is similar to that of the fox-squirrel. They are also very fond of the berries of the black-haw, (*Viburnum lentago.*) They are more prolific than the other species, from four to six young being produced at a birth; two and perhaps three litters are brought forth each year, the first quite early, generally in March. The gravid female is very shy and silent, keeping close in the hole, and venturing out for food with caution.

The migratory squirrel is somewhat social; several will feed together, and five or six occasionally inhabit one hole in winter. Where not much hunted, it is noisy and bold. Frequently, when a dog barks or a gun is discharged in the woods where they abound, dozens of them will commence barking in every direction. They do not love the neighborhood of man, and though they much affect the fruits of the farmer's labor in the corn-field, when they can steal it without coming too near the house, they will not take up their residence near his dwellings.

BLACK-SQUIRREL.

[PLATE VI.]

Sciurus niger, LINNÆUS.

DESCRIPTION.—This is a little larger than the migratory squirrel. It is all over jet-black, with the exception of a few whitish hairs on the under surface. The fur is very soft and glossy; the hairs on the back are not annulated, as in Sciurus migratorius. There are no varieties in color.

This species is considered by some naturalists to be a variety of the migratory squirrel; and it possibly may be so. It has not

been seen to breed with this squirrel, however; and, if only a variety in color, it is a remarkably permanent one in a species so variable. Some of its habits seem to differ from those of the other, though they are mostly the same.

The black-squirrel has been observed through the Middle States, in Michigan and Wisconsin; and Audubon and Bachman speak of specimens received from Lake Superior. I have seen them from Indiana in the Chicago market, and have shot some in Northern Illinois. It appears to be nowhere a common species; and all hunters agree that it disappears before the migratory squirrel, which is said to drive it off.

In Northern Illinois, I have always observed this squirrel in swamps or low river "bottoms," and never in the high prairie groves, where the migratory squirrel is sometimes abundant. It is worthy of remark that it sometimes appears to love the vicinity of rivers or ponds of water.

SOUTHERN GREY OR CAROLINA SQUIRREL.

Sciurus carolinensis, Gmelin.

Description.—Size somewhat smaller than the migratory or northern grey and black-squirrels. It is of a rusty-grey color above; on the belly, it is pure white; the feet and face are somewhat tinged with rufous. These colors do not vary, and the species may thus at once be distinguished from Sciurus migratorius, wherever it abounds.

This species is a Southern squirrel, and is most abundant in some of the Southeastern States. Audubon and Bachman say it is not numerous in Alabama and Mississippi, and that it has not been seen west of the Mississippi River. I have received specimens, however, from Miss Helen Tennison, of Monticello, Mississippi, who informs me that it is common in the woods along Pearl River. It is found in Virginia and Southern Ohio. In Southern Illinois and Indiana, it is exceedingly abundant. At Cairo, in this State, I saw specimens which had been shot in Kentucky, and I was told that it was abundant in the western part of that State as well as in South-eastern Missouri. It doubtless exists throughout Kentucky and Tennessee. Dr. Hoy informs me that he saw it, in considerable numbers, through Central Missouri, along the Missouri and Osage Rivers. In the more heavily-timbered districts, along the Mississippi and Illinois Rivers, this squirrel abounds, even in Northern Illinois. I believe it is never found in the prairie groves nor oak openings; but in the prairie regions, in the northern counties of this State, it is occasionally met with in heavy timber on the low river-bottoms, or in those skirting Lake Michigan. In this locality, it is known among hunters as the "Silver-grey Squirrel."

The Carolina squirrel delights in the heavy timber on low bottom lands. It even finds a favorite home in the deep shade of cypress swamps, where the sombre drapery, formed by the hanging tillandsia, gives them a dark and sad appearance, but which, wonderfully, is enlivened by the numbers of squirrels that run about the trees, and leap from limb to limb, or sit perched upon the branches, saucily eyeing the traveller, who, delighted by their merry activity in this gloomy place, pauses to observe them. In Southern Illinois, where this and the fox-squirrel are the only species found, it is much more numerous in the swamps and river bottoms than on the high ridges.

This squirrel is very generally confounded with the Sciurus migratorius of the North, and naturalists have made much confusion by falling into this error. DeKay, in the "Natural History of New York," calls the migratory squirrel Sciurus carolinensis; and some other naturalists still persist in considering the two identical. A little attention to the habits of each would convince any one of the propriety of considering them as distinct.

The food of the Carolina squirrel is much the same as that of the two species already described. They bury nuts and acorns in the leaves, and late in winter feed largely upon buds, being particularly fond apparently of those of the soft maple and the elm. Like the others, they incur the wrath of the farmer by their ravages in the corn-field, where they devour the grain on the stalk and carry off whole ears to the woods.

From three to six young are produced at a birth by this species. Two, and possibly sometimes three litters, are brought forth in a year. They are rarely produced in the nests of leaves.

LITTLE RED-SQUIRREL.

[PLATE VII.]

Sciurus hudsonius, PENNANT.

DESCRIPTION.—Length of adult male in winter, from nose to root of tail, 8¼ inches; tail, (vertebræ,) 5⅛ inches; tail to end of hair, 6⅝ inches; hind-foot, 1⅞ inches; breadth of tail with the hair in natural position, 1½ inches; back, light greyish-brown, with a dorsal stripe of bright reddish-brown; tail, bright reddish-brown above, dingy-brown below, with a subterminal border of black; under parts of head and body, pure white. This is full a third smaller than the migratory squirrel; the hairs clothing the body are much shorter, and the tail less bushy. There are no distinct varieties, though the colors of the upper parts are sometimes—if not generally, at the East—much redder than in the specimen here described, being without the dorsal stripe of a color so different from that of the rest of the back. Other specimens from Ohio are colored like that described.

This pretty and active little animal is well known through the Northern States, under the names of "Red-Squirrel," "Chickaree," "Pine Squirrel," and, sometimes, "Mountain Squirrel." It is a

Northern species, but has a wide geographical range. It is found abundantly throughout the Eastern and Middle States, and probably exists as far to the northward as the pine and spruce occur. Southward, in the Atlantic States, it is found in the mountains of Virginia, and, according to Audubon and Bachman, it has even been seen within North Carolina. In the interior, it abounds in Ohio and Indiana, and is found sparingly in heavy timber in Illinois; but it is not common, if it occurs at all, in the southern parts of these States. West of the Mississippi, it has rarely been seen in Northern Missouri. It is found in Central Iowa, and is abundant in parts of Southeastern Minnesota, where, in fact, it is the only species. About Lake Superior, in Northern Minnesota and Wisconsin, where no other squirrel prevails, it is found in exceeding abundance. It probably exists further to the west, but on the other side of the Rocky Mountains it is replaced by other small species closely resembling it.

The natural home of this squirrel is in heavy timber on high land. It is not found in the small, sparsedly-timbered prairie groves, nor in the oak openings. It loves to take up its residence among evergreens, the cones of which form its favorite food, those of the black-spruce particularly. In cultivated districts, it sometimes departs from its natural habits. It becomes accustomed to man's presence, living sometimes in trees quite near dwellings, and frequently in out-houses, in winter, when it comes fearlessly about the house and corn-crib. It is attached to its home, and will not leave its favorite tree unless much molested.

Unlike any other of the true squirrels found here, this species sometimes, but not generally, lives in holes in the ground. Unlike the others, too, it collects into its hole in autumn an ample provision of the good things of squirrel life, wherewith to console and sustain itself in the uncomfortable season of frost and snow. It is well known that the chickaree makes large hoards of nuts, acorns, and seeds. These are deposited in hollow trees, and sometimes under fallen logs, and even occasionally in holes in the ground. In consequence of his good cheer, this squirrel is seen actively scampering about in cold weather, when his hungry cousins cannot pluck up courage to leave their warm abodes, even in search of food. In the corn-field, his depredations are at times the source of much annoyance to the farmer. Besides eating at the time with others, this provident species is said to carry off corn to its hole for winter use.

The red-squirrel runs with great swiftness; and though it cannot leap as far as the migratory species, it darts along the trunk of a tree much more rapidly. Its note is a merry, shrill *chir-r-r-r-r*, very unlike the "bark" of the migratory and fox-squirrels.

Like the red-fox and some other animals, this squirrel appears in some instances to follow the settlements of the white man. In parts of Northern Illinois, where it was not seen formerly, it is now occasionally found, and is increasing in numbers. Dr. Kirtland speaks of it as having scarcely made its appearance, about the beginning of the present century, on the Western Reserve, in Ohio, where it is

now exceedingly abundant. It may be, however, that this appearance of the red squirrels in these localities, is the result of the destruction of certain enemies. It is very certain that they were abundant further to the west and north, before any settlements were made there.

COMMON FLYING SQUIRREL.

[PLATE VII.]

Pteromys volucella, GMELIN.

DESCRIPTION.—Length of old male, in March, from nose to root of tail, $4\frac{1}{2}$ inches; vertebræ of tail, 3 inches; tail to end of hair, $3\frac{7}{8}$ inches; hind-foot, $1\frac{1}{4}$ inches; breadth of tail, hairs in natural position, $1\frac{1}{2}$ inches; width across the back from side to side, including fur, with the flying membrane extended, 4 inches; length of supplemental bone supporting the flying membrane, $\frac{3}{4}$ inch. This is certainly the most beautiful of our rodents. In the specimen before me, the long and exquisitely soft fur, is slate-colored, tipped with creamy-yellowish drab on the back, the top of the tail brownish-drab; on the under surface, milk-white, tipped with cream color at the outer edges of the flying membrane and toward the tail, the under surface of which is very light brownish-yellow, tinged with cream. The large prominent eyes are black and lustrous; the whiskers long, and the nearly-naked ears rather large. The tail is densely clothed with soft hairs, and smoothly flattened; the feet are slender, with small arched nails. The skin on the side is extended outward, to form a membrane which is attached to the legs, and to a supplemental slender curved bone, articulating with the joint of the fore-foot. When this membrane is stretched, the animal is enabled to sail through the air to some distance, by the force gained in descending from any elevated position, being aided in this by the flattened tail, which also serves as a rudder. It is not to be supposed, however, that the flying squirrel can propel itself through the air, like a bird or bat. The tail and membranes only form a sort of parachute, to buoy it up while the force gained by the descent, and by the spring made, carry it forward. When it is about to alight, it sails upward, by using the tail and hinder parts as a rudder, the momentum acquired being sufficient to raise it for some height at a considerable curve.

This, and several other American flying squirrels, and more from the Old World, form an exceedingly interesting group in the family Sciuridæ, from the other members of which they differ materially in some of their habits. It probably exists throughout the whole eastern part of the Union. Its habitat being strictly among the trees, it cannot of course abide on the prairies, nor is it found generally in our smaller prairie groves; though it is as abundant in the large woods of Northern Illinois as elsewhere.

The flying squirrel is as active as the true species, but, unlike the rest of the family, it is nocturnal, and does not move about by day, except at times in cloudy weather. It prefers the twilight or dark-

ness, when it leaves its retreat for amusement or in search of food, seldom travelling on the ground, but sailing gracefully from tree to tree, running up toward the top of one, and alighting lower upon the trunk of another. It is gregarious, living in hollow trees in large companies. It usually prevails in greater numbers, wherever found at all, than is generally supposed. If, in passing through the woods, any one will strike the sides of old hollow trees, he will frequently see a number of these singular and beautiful little animals rush out of a hole, and sail off to the neighboring trees. It does not build nests of leaves among the branches, like the true squirrels. I am informed by Mr. Brendel, of Peoria, however, that a female was observed by him to bring forth in a deserted bird's nest. From three to six young are produced at a birth. Its food appears to be similar to that of the true squirrels. It eats corn and other grain, though, as it does not willingly leave the trees, the amount is probably inconsiderable, compared with that taken by the true species.

Flying squirrels appear, sometimes at least, to lay up stores of food for winter, at which time, they are active. I am informed of a number of instances in which they have entered the garrets of cabins in the woods to feed upon the corn deposited there.

A specimen kept in a cage became quite tame in a few days. Unless disturbed, it remained quiet during the day, curled up in its nest, with the head drawn down to the abdomen, and the flat tail laid over its head and upon the back. It would take food offered it during the day, but the light seemed to be painful to its eyes. In the evening, it began to spring and climb about the cage, and was active all night. This species has frequently been known to take up its residence, voluntarily, in or about human dwellings. It is quite easily domesticated, and being gentle, and very beautiful, makes a pleasant and interesting pet.

STRIPED GROUND SQUIRREL, OR CHIPMUCK.

[PLATE VIII.]

Tamias striatus, LINNÆUS.

DESCRIPTION.—Length of head and body of the adult male, in summer, $6\frac{5}{8}$ inches; vertebræ of tail, $4\frac{7}{8}$ inches; tail to tip of longest hair, $5\frac{5}{8}$ inches; breadth of tail, hairs in natural position, $\frac{5}{8}$ inch. Upper parts brownish-grey, yellowish on the sides; two light yellow and four black lines on the back; the rump bright brown; belly white; tail not bushy nor flat, as in the true squirrels.

This beautiful and familiar little animal, with several other species, compose the genus Tamias. Though closely related to the

true squirrels, they differ in habits and organization from their larger kindred, to suit their life on the ground. All the ground squirrels are of small size, living in burrows in the earth, and not habitually climbing trees. Their form is adapted to running on the ground and burrowing. They have capacious cheek-pouches, in which they carry large quantities of food to store up for winter provisions

The chipmuck exists throughout the Eastern, Middle, as well as in some of the Western States, and as far north as latitude fifty degrees in the British Possessions. It is found in Minnesota, Iowa, and, rarely, in Northern Missouri. I did not observe this species in the heavily-timbered districts of Southern Illinois, and Colonel Ashley, of Jonesborough, informs me, it is rare, if found at all, in the southern part of this State. Though abundant in the prairie regions of Illinois, this species never leaves the woods. It is well known to every farmer living within its habitat, under the name of "Striped Ground Squirrel," "Chipping Squirrel," or "Chipmuck." Audubon and Bachman say it is called "Hackee" at the East; but I have never heard that name applied to it here.

Wherever it abounds, the chipmuck attracts attention by its beauty, industrious habits, and cheerful activity. Not being a tree climber—and, in fact, preferring somewhat open ground to deep woods—nor fearing the neighborhood of man, it is found most abundantly burrowing under stumps, logs, or fences about cultivated land, and seems rather to increase than diminish in numbers, as the forests it inhabits are cleared for cultivation.

In spring and summer, chipmucks make love, rear their young, chase each other over the stumps and logs, in play, and enjoy themselves in various other ways; and with autumn and its harvest-time comes their season of hard work. We are not to suppose, however, that this work is at all disagreeable to them, as man's duties are to him, when he will not cheerfully obey the laws of creation. They may now be seen hastening to and from their holes, their cheek-pouches distended with nuts, acorns, and seeds, or with grain stolen from the neighboring fields. Thus they continue to collect food till cold weather has set in, when they retire to their burrows, where, with well-filled larders, they pass the winter comfortably, regardless of the cold winds which rage above them. This species closes the entrance to its burrow late in autumn, and appears to pass the winter in a state of semi-hibernation; for, though taking nourishment, and not torpid, it never comes out, except very rarely in long-continued mild weather.

Like the true squirrels, the chipmucks are properly nut-eaters, though they feed rather more upon the seeds of small plants than their arboreal relatives; nor do they subsist upon the buds of trees. Dr. Hoy informs me that he once observed a number of chipmucks climbing the bushes of the prickly ash, (*Xanthoxylum americanum,*) to obtain the berries which they were carrying to their burrows in considerable quantities. At another time, he saw one repeatedly climb a hickory and cut off the unripe nuts, which were brought to

the ground, and, while yet covered with the green pericarp, placed in a hole at the root of the tree, which, however, was not its burrow; and he was told that the same individual was noticed to carry away nuts in this manner for some days. Though this species does not generally climb trees, except when pursued, I am inclined to think it does so voluntarily more frequently than is supposed.

The quantity of nuts, acorns, and seeds sometimes collected by these industrious little fellows is astonishing. They are frequently stored temporarily under logs, and in shallow holes under roots of trees, and afterwards removed to the burrow, at a more leisure season. I have known lazy people to watch the chipmucks in nutting time, and finding where they carried their stores, dig them out, saying they could thus get nuts faster than by picking them up themselves. In a burrow dug open in November, I found over half a bushel of hickory-nuts and acorns. These were not all in one place, but in four or five enlarged chambers, in different parts of the burrow, which was complicated, and consisted of several winding and intersecting passages, situated not over a foot below the surface. The entrance to the burrow was under a log, and the passages extended several feet on every side. A large nest of leaves and grass was placed above the surface, under the rotten log. Only one of the inhabitants was found, but he was quite active.

This ground squirrel is sociable; and sometimes, though not always, several pairs occupy the same burrow in winter, the store of food being common property. These, like the true squirrels, stand erect on their hind-feet, when eating, using the fore-paws as hands. The power of their incisors is wonderful; they cut with apparent ease through the shells of the seeds of wild plums, which would resist the point of tempered steel.

At times, the note of the chipmuck is a short deep *cluck*, repeatedly pronounced, without variation; and on a sunny day, he will sometimes utter it for an hour at a time, being meanwhile perched upon a stump or log; but more frequently the note is a shriller *chip-chip*. When alarmed, he utters a low chatter.

The amount of grain stolen by chipmucks is seldom of much value; though, where they are so abundant as to attack a field by hundreds, the result of their depredations may become quite an item of loss. The most serious cause of complaint against them is, the injury done by digging up corn when first planted. They go along the rows like the black-birds or spermophiles, and, guided by the sprouting blades, dig out the grains, or even take them before they sprout, and in this way frequently cause considerable damage. Chipmucks, generally, however, cannot be considered as great enemies to the farmer. They are oftener destroyed by rapacious birds and mammals than the true squirrels, though, being considered of no value as food, they are not so frequently killed by man. Our small weasels are known to kill many; the mink often makes a meal of them; and even the foxes and wild-cats do not disdain to devour every unlucky little individual they can catch, while many are eaten by birds of prey; so that it is no matter of surprise that

they should increase in cultivated districts, where they are in a measure protected from their natural enemies. When they become so numerous and destructive as to render it necessary to kill them off, they may be easily shot, or caught in any kind of a trap, as they are not at all suspicious; and they could probably be poisoned with arsenic, mixed with meal, and placed near their burrows. Several ferrets and terrier dogs would quickly clear a farm of them.

Other ground squirrels, closely resembling this in appearance and habits, exist in the western parts of the Union. I learn from Dr. Hoy that the four-lined ground squirrel (*Tamias quadrivittatus*, of Say) is found in Northern Wisconsin. This species, as observed by him in the Lake Superior region, appeared to have habits similar to those of Tamias striatus, though its voice differs so much as to be readily distinguishable from that of the latter, the note being longer and on a higher key.

PRAIRIE SQUIRRELS, OR SPERMOPHILES.

These are with great propriety called "Prairie Squirrels," for their true home is on the prairie, where they replace the "arboreal" squirrels, from which they differ in organization, to suit their necessarily different mode of life. While the true squirrels are designed to live in trees, and to subsist upon their fruits, the spermophiles are fitted to inhabit the grassy plains which cover much of the western part of our Union, their food being the prairie plants with their roots and seeds. The form of these squirrels is adapted only to locomotion on the ground. The body is thick and heavy, with short legs, and, in place of the long toes and sharp-hooked nails, by which the arboreal squirrels cling to the trees so readily, they have shorter toes with longer and straighter nails, for digging burrows in the earth. The long, flexible and bushy tails, which aid the squirrels in their bold leaps, and keep them warm in their holes in winter, would here be useless, and soon worn ragged by dragging through their burrows. The spermophiles, therefore, have smaller tails, that are carried straight behind them. They have cheek-pouches, in which to carry food; and two species, at least, convey roots, seeds, &c. to their burrows to be eaten.

In winter, there would be little food or shelter for them on the frozen and snow-covered prairies; and so the spermophiles make one long night of it, and sleep away the season of frost. The peculiar state of torpor in which these and some other rodents, as well as a few carnivorous mammals, pass the winter, is an admirable provision in the economy of Nature. At the approach of severe cold, in autumn, the prairie squirrel retires to its burrow, the entrances to which are tightly closed with earth, to exclude the frost. In the large nest of grass he curls himself up, with his head against the abdomen, and falls into a state of torpor, out of which

he does not awaken until the return of warm weather in spring. In this state, he takes no nourishment, whatever, nor does he move.

If cut or bruised, he exhibits no signs of feeling; and to all external appearances seems dead. Respiration and the circulation of the blood are carried on very imperfectly; but slight oxygenation of the blood takes place, and little heat is generated—the body being cold. There is no secretion nor excretion, and very little waste of tissues occurs; and thus the necessity for food is obviated. From this state, he is at once revived to activity by the simple application of heat. Placed in the cold, he again becomes torpid. It is to be observed that the species, which passes the winter thus in profound torpor, if removed to a warmer climate, or if kept in a warm room, will remain active during winter. Thus we see how, in the perfect laws of Nature, it is ordered, that the hibernating animals shall fall into this state of torpor only when they would suffer from cold and want of food, if active.

These, like the true squirrels, are strictly diurnal. Most of the species are inclined to be gregarious, while some live together in large companies. The flesh of several is said to be palatable, though I am not aware that either of our two prairie-squirrels is eaten, in this vicinity. Two species have rendered themselves obnoxious to our prairie farmers.

STRIPED AND SPOTTED PRAIRIE-SQUIRREL.

[PLATE VIII.]

Spermophilus tredecimlineatus, MITCHELL.

DESCRIPTION.—Length of adult male, in September, from nose to root of tail, 7 inches; tail, (vertebræ,) $3\frac{5}{8}$ inches; tail to tip of longest hair, $4\frac{1}{4}$ inches; hind-foot, $1\frac{1}{2}$ inches. On the back and sides there are nine stripes of a dark-brown color, with a row of yellowish dots along each of the five central stripes, which are the broadest and most distinct. Alternating with these brown stripes, are eight narrow lines of yellowish-grey; thus making seventeen in all, which shows Mitchell's name to be not very characteristic. The lower lines are indistinct, and in some specimens, cannot be traced. The under parts of the body are yellowish-brown.

This little animal, so well known on our prairies, resembles the common chipmuck, (*Tamias striatus*,) and is of about the same size, or a little longer. It abounds in the prairies of Michigan, Wisconsin, Minnesota, Iowa, Northern Missouri, Middle and Northern Illinois, and Northern Indiana. It is only found in the northern edge of Missouri. In Illinois, it is most abundant in the northern part of the State; and it does not exist at all below latitude thirty-nine degrees, if it does as far south as that. It is not found east of the prairie regions, nor oak openings, of Indiana and Michigan, except

rarely in the northeastern corner of Ohio. At the North, Richardson found it towards latitude fifty-five degrees, in the British Possessions; it has been seen as far west as Fort Laramie, on Platte River. Audubon and Bachman state that it is found abundantly on the Upper Missouri, and that it is said to extend along the prairies east of the Rocky Mountains into Mexico.

In Iowa, Wisconsin, and Northern Illinois, where this animal is abundant and much complained of by farmers, it is universally called "gopher." The true gopher (*Pseudostoma bursarius*) being also found in Iowa and Illinois, the two animals are frequently confounded; and such is the profound contempt of some farmers for any systematic study of natural history, that, though repeated descriptions of both these animals have been published in various agricultural journals, they go on correcting each other's statements, after a fashion, in preference to learning first what they are writing about. One, who knows only the true gopher, burrows of which are miles in length, very naturally laughs at another for saying he drowns out hundreds of gophers, (meaning prairie-squirrels,) by pouring a pailful or two of water into a burrow; while the latter must be very careless, to state that gophers cut the roots of trees, gnaw vegetables, and injure fields by throwing up hills. The pseudostoma undoubtedly has the best right to the name of "gopher," and should retain it. Our farmers would obviate needless and frequent confusion, if they would not apply the same name to the present species, for which the designation "Striped Prairie Squirrel" would be far more appropriate; and which, in fact, is highly characteristic, being in itself a description of the animal. To call it "Ground Squirrel," as is sometimes done, is bad, because the Tamias striatus is well known as the "Striped Ground Squirrel." In Northern Illinois, I have heard the German farmers very generally call it "Fence Mouse," which name they also apply to the Tamias striatus.

This species is emphatically a prairie animal. It never inhabits timber lands when there is prairie in the vicinity. Though it may be found in oak openings, it is never in heavy timber; and, when living in these openings, it is always most abundant on the edges of open ground, or where the trees are most scattering.

I am not aware that this prairie-squirrel ever inhabits ravines,* in preference to level ground, though Spermophilus franklinii sometimes appears fond of burrowing in banks. The favorite habitation of this species is on dry prairie knolls. It is naturally gregarious, and though never observed living in such great companies as the prairie-dog, twenty, or sometimes even fifty or a hundred may be found within the area of an acre, two burrows being frequently within a few feet of each other, though one is never inhabited by

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* In the Patent Office Report for 1853, Dr. P. R. Hoy, of Racine, Wisconsin, gave a highly interesting and original account of this animal. In that article, as printed, this species is stated to be abundant in the ravines of Wisconsin, but he informs me that this is an accidental error, "ravines" being printed where "prairies" was intended to be expressed.

more than a pair. In passing near a knoll inhabited by them, numbers may be seen standing upright at the entrance of their burrows, so straight and motionless as to be easily mistaken for as many sticks. But, as you approach one, he will disappear, by a movement so rapid that he can scarcely be followed by the eye; and, if it were not for the whistling chatter accompanying his disappearance, you might think your vision had deceived you, and that nothing had been there. But, upon stepping back several rods, it is more than likely that he will have resumed his position before you are aware of it. If you remain close to his hole, he will only thrust out his head and eye you suspiciously.

The striped spermophile leaves its burrow with great caution, and only for a short distance. At the slightest alarm it silently glides back through the grass, yet with great rapidity, keeping close to the ground, and never leaping. Its burrow reached, unless closely pursued, it stops for a moment at the entrance, sitting upright on the tarsi, and then suddenly pops into the hole, uttering several quick, clear, whistling notes. Unless it has been very much alarmed, it will always thrust out its head again to reconnoitre; and boys, taking advantage of this practice, often catch these animals by slipping a noose arranged over the hole, the moment one has entered. When one is shot near his burrow, the body can seldom be secured, for, like the prairie-dog, unless cut to pieces by the shot, he will manage to tumble into his hole.

Before the production of the young, in May or June, the old male leaves the female, and appears to lead a solitary and more or less wandering life, digging a temporary burrow, or occupying a deserted one for a few days, wherever he may take up his abode. These summer burrows may often be found, and sometimes are of considerable extent; several of those which were examined were more than 20 feet in length, being simple galleries from six inches to a foot below the surface—deeper in sandy soil—opening at both ends, with the nest placed in a small side-chamber; others were of much less extent, sometimes with but one entrance, and sometimes without nests. The winter burrow, in which the pair hibernate and the female brings forth her young, is deeper and more complicated, having always two entrances, or more. In this, in a side-chamber of suitable size, excavated above the level of the rest of the burrow, is a large spherical nest of soft grass, entered by an opening on one side. This nest is sometimes of the size of a half bushel, the interior being generally lined with softer material than the outside. The young are produced at the end of May or early in June. I have observed from five to nine brought forth at a birth, and I am informed of two instances in which ten were found in a nest; but the number is variable, the usual number being six or seven. The young at birth are naked, blind, and remarkably embryonic. Dr. Hoy, who observed them in confinement, says that they have no hair on the body before they are twenty days old, and that the eyes do not open till the thirtieth day. They continue to require the nourishment and care of the mother for a much longer period than

most rodents. During summer, they begin to dig shallow burrows, and leave her before winter, to shift for themselves. Hibernating mammals require to be in good condition when they retire to winter-quarters, which the females could scarcely be, did they rear young late in the season. This spermophile and probably the rest of the genus produce but one litter of young a year.

The natural food of the striped spermophile is the grasses, with their seeds and roots, as well as those of various other herbaceous plants, and even the most minute seeds of annuals. Mice and insects are also known to form a part of their food. Many of our farmers suppose that this animal feeds, in winter, upon stores of provisions laid up in its hole for that season; for, though it spends the winter in a state of profound torpor, it collects food in its burrow. This is done in spring and summer, as well as in autumn. Considerable stores of grain, seeds, roots, &c., are found thus collected, in large side-chambers excavated for their reception in the burrow. Corn, wheat, and oats are stored up, when taken from the newly-planted fields in spring, with buckwheat and winter wheat later in the season, as well as heads of grain taken from the edges of the fields in harvest time. I have seen more than a quart of crab-apples taken from the burrow of one which had carried them several rods from a tree. George and Frank Kennicott inform me that they observed one, the burrow of which was near a lone burr-oak, on the prairie, to carry great quantities of acorns into his hole; and another was killed by them, the cheek-pouches of which were crammed with the dry ovaries of a prairie plant, the seeds of which were exceedingly minute. From this, it would appear that the striped spermophile at all seasons carries portable articles of food to its burrow to be eaten. He certainly takes no food from the time he first becomes torpid, in autumn, until he again becomes active, late in the following spring. In Northern Illinois, these animals generally go into winter-quarters late in October, usually retiring at the first appearance of hard frost, though a few keep out longer; and I have observed several, in warm weather, as late as the 10th of November, after the ground had been frozen an inch deep, and there had been constant frost for several days. In spring, they rarely leave their burrows before the frost is fully out of the ground. To Mr. William Bebb, of Fountaindale, Winnebago county, Illinois, I am indebted for the following dates of this spermophile's first appearance in spring, as noted in the meteorological register of Mr. Edward Bebb: "1851, April 10th; 1852, April 11th; 1853, April 2d; 1854, March 29th; 1855, April 12th."

Among farmers, this spermophile has a bad reputation, in consequence of its injuring corn-fields by digging up the newly-planted seed, in spring. Persons residing on newly-broken prairie inform me that they sometimes suffer severely from the prairie-squirrels. It is said that large corn-fields have to be replanted, where they have been at work, while, in some districts, every corn-field is seriously injured by them. No sooner is the corn planted, than they begin to work at the edges of the field next to their burrows. They show

much intelligence in following the rows, sometimes digging up every hill for several rods, and this before, as well as after the corn has sprouted. They are industrious, and take up a great deal of corn in a day, which, apparently, is always carried to the burrow. In such districts, farmers agree that their injury to corn-fields is on so extensive a scale as to render the destruction of the prairie-squirrels a matter of serious interest. They also do more or less injury, by digging up garden seeds, such as peas, melons, &c., and, though rarely, are more seriously injurious, by destroying apple and osage orange seeds in nurseries. I am not aware, however, that they are ever accused of gnawing bark, destroying growing vegetables, or, in fact, of injuring the farmer in any other way than by devouring grain and seeds. In consequence of this reputation for mischievous habits in the corn-field, farmers all appear to think it a good deed to kill a spermophile. But they should not be too hasty; for, as far as the present species is concerned, there is something to be heard in its favor. In the Patent Office Report for 1853, page 68, Dr. Hoy has shown that this animal feeds upon mice and insects when in captivity, and he further informs me that he has examined burrows in which the numbers of the skins of meadow-mice found sufficiently proved the appetite exhibited by his caged specimens to be natural. Those observed in captivity, killed and devoured mice in the same manner as the weasel, showing themselves to be adepts at this mode of procuring food. One would spring upon a mouse savagely, uttering a low snarl, and despatch it by biting its neck, after which the top of the skull was taken off, the brains licked out, and the blood sucked, the body not being devoured when there was an abundant supply. There can be no doubt that meadow-mice and insects are largely eaten by these animals whenever they can be obtained; and the high probability is, that their good offices in the destruction of these, far more than counterbalance their occasional injury to corn-fields. I doubt their being so very injurious in long-cultivated farms. The first few crops of corn planted on newly-broken prairie, inhabited by striped spermophiles, suffer from their ravages; and so a hue and cry is raised against them, and their actual depredations are much exaggerated. This animal disappears before the plough, and, as it will never leave its burrow for any great distance, it does not generally invade well-cultivated fields, nor attack corn except at the sides of the field next to wild prairies or meadows inhabited by it. In Northern Illinois, I have observed large corn-fields, raised on farms in the meadows of which this spermophile abounds, where, if it does any harm at all, it is so inconsiderable as not to be noticed. Dr. Hoy says that in a large neighborhood in Southern Wisconsin, where these spermophiles are very numerous, he knows of but one farmer who kills them, nor is he able to hear that they do any considerable injury.

When, in newly-cultivated districts, it becomes necessary to exterminate the striped spermophile, it can be done with ease. It is readily trapped or shot, and a few bucketfuls of water will always drown one out of its hole. But in killing this animal, let farmers

consider whether they are not destroying a friend. Let all observe critically how many mice, grasshoppers, &c., it destroys, and then treat it accordingly. This species suffers but little, when at all, from rapacious animals. It leaves its burrow with so much caution, and is so constantly on the alert, as to be rarely exposed to their attacks. Hawks are not observed to catch, nor even to hunt for them.

GREY PRAIRIE-SQUIRREL.

[PLATE IX.]

Spermophilus franklinii, SABINE.

DESCRIPTION.—Length, about 10 inches from the nose to the root of tail; the tail about 5 inches long. It is a little over three-fourths the size of the migratory squirrel, though its short hair, tail, and legs make it appear smaller; and its form is much thicker and clumsier than that of the true squirrels. The back is light-brown, dotted thickly with black; the under surface is greyish-white. The tail is more bushy than that of the striped spermophile, but much less so, as well as much shorter, than that of the migratory species. It is not so light and active as the striped spermophile, though more so than some of the genus.

The grey prairie-squirrel (grey-gopher, of Northern Illinois) exists throughout the prairie regions of Wisconsin, Illinois, Missouri, Iowa, and probably Minnesota. It is abundant in South-eastern Minnesota, and was observed by Dr. Hoy, in Eastern Kansas. It is also said to exist a great distance to the north and west. It is found much further south in Missouri and Illinois than the Spermophilus tredecimlineatus. It is far less numerous here than the striped spermophile, and appears to be a less abundant species wherever the two exist. It is observed to inhabit the thickets of low bushes, and the edges of the timber, more than the other, but does not occur in the woods. It is fond of digging long burrows in the banks of ditches, and several times, I have seen it living in steep river-banks, as well as under small wooden culverts in roads. It is not so shy as the striped spermophile, and takes up its residence quite near dwellings. It is also less disturbed by the cultivation of land. In this region, it is usually found living alone or in pairs, and I have never observed a number of burrows scattered over a small prairie knoll like the semi-villages of the striped spermophile. This is perhaps owing to their small numbers; for the species appears to be naturally gregarious, and, at times, large companies live together, burrowing within a few feet of each other, and several pairs even entering the same hole.

This spermophile exhibits a remarkable disposition to migrate from one field to another. Not only do the males lead a wandering

life in summer, but pairs appear frequently to change their quarters, leaving their winter burrow to breed in another, and then, perhaps, hibernating in a third, at some distance from this. In several instances, a company of a dozen or more have been observed to appear in a locality where none were seen the previous summer, and then to disappear after remaining there a year, or only a few weeks. In the early part of summer, twenty or thirty of these animals suddenly made their appearance, and burrowed in an old embankment, within three or four rods of my father's house. They seemed to have lost the shyness exhibited when leading a solitary life, and were not alarmed at the near approach of man. They even came about the kitchen door to pick up crumbs, and disputed with the chickens for their food. Like the striped spermophiles, they glided silently to their burrows when alarmed, uttering, as they entered, a remarkably clear whistle twitter, more musical than the voice of any other mammal I ever listened to, and as clear as that of a bird. The same note was uttered when the animal was hurt or much frightened. They fed upon June-grass, clover, Timothy, and the broad-leaved plantain, and seemed particularly fond of the leaves of the common mustard, of which some plants grew near their burrows. Other specimens, examined in summer, had their stomachs filled with grass alone. In eating, they sat upright on the tarsi, and used their fore-feet as hands, to draw the leaves to their mouths, though their paws were used thus with less facility than those of the true squirrels. Though both the vegetable and flower-garden were situated within five rods of their burrows, I do not remember that they were observed to injure either. A number of young chickens disappearing, however, and the eggs being eaten in several hens' nests near the burrows of the spermophiles, suspicion rested upon them—probably unjustly—and a war of extermination was commenced. Several were shot, while others were killed with clubs, whereupon the survivors left in a body, as suddenly as they had come, and were never seen again, nor could they be found upon any part of the farm. I have known this spermophile to take refuge in a hollow tree, crowding up the hole like the grey-rabbit. Mr. F. C. Sherman, of Chicago, informs me that he twice saw one, when pursued, climb five or six feet up the trellis-work and vines at the side of a house.

The burrow of this species is usually deeper than that of the striped spermophile, but otherwise similar to it. The young, I have not observed, but Mr. George S. Parker, of Pecatonica, Illinois, writes me that he once saw five, and at another time seven young in a nest. They appear to go into winter-quarters in the fall, and re-appear in the spring, at about the same time as the striped spermophile. They have been found hibernating under piles of rails, and in corn-shocks; and I am informed of two instances in which one has been found torpid in a hay-stack, where he had formed a burrow in the hay. I have never heard of its hibernating in such situations. A caged specimen of Franklin's spermophile, kept by Professor Baird, of the Smithsonian Institution, was active all win-

ter; and Dr. A. M. D. Hughes, of Payson, Illinois, informs me that he found one in a burrow under a corn-shock, active in mild weather, late in November.

This species is carnivorous, though apparently less so than the striped spermophile. The specimen kept by Professor Baird was decidedly carnivorous, but one observed by Dr. Hoy did not eat mice, though it killed them when placed in its cage. Its food is generally similar to that of the striped spermophile, stores being also found in its burrow. It gnaws hard substances more than the striped spermophile, and, while the latter will not gnaw out of a box, this readily does so. Caged specimens cut open hazel-nuts also.

This squirrel injures the farmer by taking up newly-planted corn as does the striped spermophile. Being far less abundant than the other, however, it is usually less complained of on newly-broken land; but it is sometimes the more injurious of the two on old farms, where it burrows in cultivated fields more willingly than the other. It frequently burrows during summer in grain-fields, where it eats the green plants, and afterwards the heads of grain as the kernels fill; and in this manner, and by throwing down the standing grain, spoils it for some distance around the burrow. Having a great predilection for burrowing in ditch-banks, and in under drains filled with brush, it often does serious injury in this way.

This species may be destroyed in the same manner as the preceding, though they are not so easily drowned out of their holes, especially when they are in a bank or drain. They appear to leave their burrows with less caution, and for a greater distance, than the others; and, being also less active, they are sometimes chased and killed with a stick. They are probably more liable to the attacks of rapacious animals than the others. I have known domestic cats to catch them, when full-grown.

It is possible that the striped spermophile drives off this species, as the two are not found occupying the same field.

PRAIRIE-DOG.

[PLATE IX.]

Spermophilus ludovicianus, ORD.

DESCRIPTION.—Length of adult male from nose to root of tail, 13 inches; tail, (vertebræ,) 2⅝ inches. Back, reddish-brown mixed with grey and black; belly, soiled white; tail, banded with brown near the tip.

The famous "Prairie Dog," or "Prairie Squirrel," exists in great abundance on the plains west of the Missouri River, being also found over a large extent of country at the southward, and it has also been

observed as far west as California. At the southward, Captain Marcy found it above Cross Timbers, on the Red River of Louisiana. Though not properly included among the mammals of this region, this squirrel has more resemblance to our grey spermophile in color, and to the wood-chuck (*Arctomys monax*) in form, than to any other known to our farmers. Its habits are not unlike those of our grey and striped spermophiles. Like them, it is strictly a prairie animal, subsisting upon plants, and probably on some insects.

The prairie-dogs are fond of each other's company, and live together, in great congregations, their numerous burrows, situated close together, being called "prairie-dog towns." The burrow is much deeper and more extensive than that of either of our two Illinois prairie-squirrels. Like these, it is fond of standing erect near its hole, ventures from it with caution, and hastens into it when alarmed; but, as if it were inquisitive, soon puts out its head again to look at the cause of its fright. Like the rest of the genus, it hibernates. Its note is said to have gained it the name of "Prairie Dog," but its voice can scarcely bear much resemblance to the bark of a dog, and is probably more like the whistling chatter of our grey and striped spermophiles, though perhaps less musical and clear.

Numbers of our common prairie rattlesnakes, (*Crotalophorus tergeminus*,) as well as of a small owl, live habitually in the burrows of the prairie-dog. These can hardly be welcome guests of the rightful inhabitants. Though the owl probably feeds chiefly upon insects, it might devour the young; and the rattlesnake certainly does, as well as makes many a meal of the adults.

WOOD-CHUCK, OR GROUND-HOG.

[PLATE X.]

Arctomys monax, LINNÆUS.

DESCRIPTION.—The wood-chuck is about 18 inches in length from the nose to the root of the tail, with the vertebræ of the tail about 4 inches. The tail is bushy, but small; the ears and legs short; the body thick and heavy; a full-sized specimen weighing 9 or 10 pounds. The usual color of the back is grizzly-brown, with the head, tail and feet darker; the belly reddish.

The wood-chuck is familiar to the farmers of the Eastern and Middle States. It is abundant on the Missouri River, and exists westward to the Rocky Mountains. Northward, it is found as far as Hudson's Bay. In this part of Illinois, it was exceedingly rare ten years ago; but is now becoming quite common. It is an inhabitant of the woods, where it occupies the place that the spermophiles do on the prairies; and, though it burrows in open fields, and in the timber, I am not aware that it ever lives on the prairie, though I

have seen it in the prairie groves. At the East, it inhabits open fields in preference to the deep woods. This love for open ground is probably acquired. Here, I have most commonly observed it in the heaviest timber, and it is said to be found most abundantly in woodlands in Missouri. It digs its burrow under a log, brush-heap, or fence, or among rocks; and particularly delights in rocky bluffs. River-banks are also its favorite resorts. At the East, dry pastures and meadows are frequented, where it likes to dig its burrow under a fence or stone-wall, with an opening on each side.

This animal is fond of clover; and, where it abounds, a clover meadow is sure to be occupied by it, sometimes to the no small damage of the crop, which it injures by treading it down around the burrow. It is also very fond of peas, and never fails to visit a pea-field situated near its retreat. Corn and other grain are sometimes pulled down and eaten by it. It is, however, only near the burrows that it is seriously injurious, as, like the spermophiles, it leaves these with great caution, and only for a short distance.

When surprised away from home, this species always attempts to retreat to its hole, running or moving by short and awkward jumps, made apparently with much effort. It manages to get over the ground with greater speed than might be expected, considering its form, though a man can outrun one in a race by several rods. It is very watchful, and, when feeding, will frequently stand erect, with the neck stretched as high as possible, and look suspiciously about. It usually stands on the hind-feet, in feeding, as it frequently does at other times.

From four to six young are produced each season. These are brought forth in the early part of summer, and, before fall, leave the mother, to dig their own burrows and shift for themselves. The female exhibits considerable affection for her young, and seldom deserts them when in danger. The old males appear to lead a solitary life, in summer, like the spermophiles, leaving the family den to the female and young. Only a single pair of adults occupy the same burrow. The hibernation of the wood-chuck is as profound as that of the spermophiles. Naturally, this animal is strictly herbivorous. Though living in the woods, it does not eat nuts, nor gnaw bark, nor am I aware that it ever digs roots. It is not a tree climber, though it sometimes crawls up a leaning tree, or into the thick branches of bushes overgrown with vines, on which it is fond of lying in warm sunny days. In this vicinity, I have often found a number of them taking refuge in standing hollow trees, entering a hole at the ground, and climbing up the cavity in the manner of the grey-rabbit.

When fat, which they usually are in autumn, wood-chucks are esteemed by some as good eating, if properly cooked. They are sometimes baked whole, or are better, if parboiled in milk, and afterwards "potted down."

The fur of this animal is of no value, but the dressed hide is very tough, and highly esteemed among the back-woodsmen for making whip-lashes, money-pouches, and various other articles of use.

MEADOW-MICE.

Of Meadow-mice, we have many species, some being found in nearly every part of the United States. They all resemble each other; and, where several species are found in one locality, they are commonly considered by farmers as one animal, known under various names, as "Short-tailed Field Rats or Mice," "Bear Mice," "Bull-headed Mice," "Ground Mice," "Bog Mice," &c., while many persons call them "Moles," though they are not in the least related to that family. They are all of small size, with shorter and heavier forms than the true mice; the eyes are small; the ears short and mostly concealed by the fur, which is soft, thick and very generally of a dark color on the upper parts; the head is large; the snout blunt; and the tail short.

The food and general habits of the different species are much alike, though some prefer high, and others wet ground; while others inhabit the woods, prairies, &c. All the species burrow, and none climb trees. The common food of those I have observed is the grasses and other herbaceous plants, their seeds and roots, and the seeds and acorns, as well as the bark of trees, in the woods, with grain and vegetables, when inhabiting cultivated fields. Some are omnivorous as has been observed in their habits while in captivity. To what extent they eat animal food, when at liberty, I am unable to say, though it is probable that they consume some insects in summer; and they may even obtain a few, with the pupæ and eggs of more, concealed in the grass, traversed by them in winter. Some kinds, at least, lay up stores of food for winter. All are active at this time, moving about in the coldest weather, and never hibernate like marmots.

One characteristic, certainly possessed by all the species in common, is their ability to destroy the products of the farm. I know of no mammals more injurious to the farmers in Northern Illinois than these seemingly insignificant little meadow-mice. Few, if any, escape their depredations, though the full amount of damage done by them is but little known; and yet they are usually thought even unworthy of consideration. Such of our farmers as cut their corn and leave it standing in shocks for some time in the field, as is usually done here, will find upon examination that in many, if not every one of the shocks, there may be found one or more pair of meadow-mice, which have dug for themselves burrows in the ground beneath, and have often carried thither a store of corn; while in these, or ensconced in the protecting corn-stalks above, they have built themselves a nest, in which they can lead a very comfortable sort of life, regaling themselves, when hungry, upon the corn. Now, a pair of mice will not, it is true, eat enough corn to alarm a farmer for the safety of his crop; but let any one examine a large field of corn, thus cut and left standing on the ground a month or

two, where these mice abound, and carefully estimate the average amount of corn destroyed in each shock, observing that which has been buried in the burrow; and then multiply that by the number of shocks inhabited by these pests, and it will be often found that they have really consumed or destroyed a large amount. In meadows, they do much injury by devouring the roots and stems of Timothy, clover, and other plants used for hay. This mischief, however, is seldom noticed by farmers; or, if it is at all, in districts where moles abound, all the blame is laid upon them, as indeed, is very much of the damage done by meadow-mice wherever the two exist together. They also do great mischief by killing young plants in grain-fields; and, soon after the seed is sown, they destroy many of the grains, little stores of which may be found collected in shallow excavations. These are often not eaten, and, germinating, astonish and scandalize the farmer by the appearance of a thick clump of plants where he thought he had sown his seed quite uniformly. They also dig up grain that has just sprouted; and, by examining fields of young wheat, oats, &c., spots will be seen where they have dug down, guided by the growing blades, and taken off the grain. In a nursery, where apple-seeds were planted in autumn, I have observed that, during fall and spring, so many of the seeds were dug up by these mice as to leave long gaps in the rows of seedlings, the empty shells of the seeds being found lying about the rows from which they had been taken. They congregate in stacks of grain and hay, sometimes in exceedingly great numbers, destroying all the lower parts, by cutting galleries through them in every direction.

The greatest mischief done by meadow-mice, is the gnawing of bark from fruit-trees. The complaints are constant and grievous, throughout the Northern States, of the destruction of orchard and nursery trees by the various species of arvicolæ. The entire damage done by them in this way may be estimated, perhaps at millions of dollars. If any think this too large an estimate, let them inquire, even in a small neighborhood, where much attention is paid to fruit-growing, and it will be found that, wherever they abound, the injuries committed by these pests are frequently among the most serious difficulties encountered by the pomologist. This is especially the case at the West, where no care is taken to protect the trees against them, careless orchardists allowing grass to grow about the roots of their fruit-trees, and thus kindly furnishing the arvicolæ with excellent nesting places, in winter, and rendering the trees doubly liable to be girdled. In the nurseries, in Northern Illinois, I have seen whole rows of young apple-trees stripped of their bark for a foot or two above the ground. Thousands of fruit-trees, as well as evergreens, and other ornamental trees and shrubs, are at times thus killed in a nursery in one winter. The mice are most mischievous in winters of deep snow. It is usually thought that they only gnaw bark when no other food is to be obtained; but it is more probable that this is palatable to them at all times. Confined specimens, while abundantly supplied with food of all kinds, ate the bark from

twigs placed in their cage. One reason why fruit-trees are most girdled in times of deep snow is, that the meadow-mice can then better move about, at a distance from their burrows, being protected by the snow, under which they construct numerous pathways, and are thus enabled to travel comfortably in search of food, always to be obtained in abundance, where there is any kind of perennial grass, or the seeds of annual plants. Aided by the snow, too, they climb up at the sides of the trees to gnaw the bark at a considerable height from the ground. Rabbits are often accused of gnawing bark from trees, when the mischief has really been done by meadow-mice. Many times, in spring, when a florist uncovers some choice plant he has carefully protected during the winter by straw, &c., he is grieved and chagrined to find, instead of a fine dianthus, or half-hardy rose, two nimble, black-eyed arvicolæ, which have found good winter-quarters in the shelter provided for the plant, that has furnished them food. Not a little injury do they to vegetables of all kinds, destroying young plants of peas, beans, cabbages, &c., as well as digging up seeds of all sorts, and gnawing potatoes, beets, and other roots. In short, the catalogue of their depredations is endless.

It is related that, some 40 or 50 years ago, a European meadow-mouse (*Arvicola agrestis*) was so numerous and destructive in parts of England as to cause great damage and serious alarm, ruining whole grain-fields, and threatening to destroy all the young trees in the New Forest and Forest of Dean. In the latter, alone, no less than thirty thousands of these animals were entrapped in three months, while great numbers were killed by birds and beasts of prey. This great increase was, beyond doubt, owing to the destruction of the animals appointed to keep them in check; hence let those of our farmers who, in their ignorance of Nature's laws, wantonly destroy them, beware, lest the arvicolæ also multiply to the same alarming extent in this country.

Meadow-mice are very prolific, bringing forth young several times a year, and usually as many as five or six at a birth. To check this enormous increase, they have numerous natural destroyers. Though mostly nocturnal, they are also active by day; and one of their greatest enemies in this vicinity is the Northern shrike, or butcher-bird, (*Lanius borealis*,) the food of which consists almost wholly of arvicolæ and a few prairie white-footed mice, (*Mus bairdii*,) during his sojourn with us, in his spring and fall migrations. This bird takes his stand, day after day, upon the same tree or fence-stake, and from this post surveys the surrounding fields, in which no mouse may now show himself in safety The result of the shrike's watchfulness and prowess may be seen, in part in the bodies of the numerous mice, fastened in the branches of bushes or on fences, sometimes partly eaten, sometimes having only the brains taken out, but oftener entire. Considering what he has devoured, besides these, the large numbers destroyed by the shrike may be readily supposed. The Southern shrike, (*Lanius ludovicianus*,) which breeds largely in the prairie districts throughout this State, is also an enemy to be dreaded by the meadow-mice. Though feeding more upon insects

than its larger cousin, and being perhaps, a less successful mouser, its destruction of arvicolæ in summer is well known, and has gained for it the name of "Mouse Bird," in Central Illinois. This bird not only pounces upon them when they are moving about, but finds the nests on the surface, and digs out the inmates with its bill and claws. A domesticated brown sand-hill crane, (*Grus canadensis*,) which I kept for several years, spent much time in hunting about the fields for the nests of meadow-mice. He became expert in finding them; and, when they were situated upon or near the surface, he would dig them out with his long and powerful beak, and, after first killing all the inmates, proceed to swallow them whole, with much apparent relish. In spring, I have seen him thus destroy several families of old and young arvicolæ in a day. Cranes are omnivorous, and large feeders, and if all are as good mouse-catchers as my pet, they must destroy great quantities on the prairie. The owls, also, devour them to some extent, in the timber, especially; while the short-eared owl, (*Brachyotus cassinii*, of Brewer,) which is strictly a prairie bird here, feeds largely upon them. This owl is diurnal, and may be seen flying low over the surface, in search of meadow-mice, in broad day, both in winter and summer. The hawks all prey upon them, too, from the little sparrow-hawk to the great red-tailed buzzard. The marsh-hawk lives mostly upon them in this region, and is observed sweeping along close to the ground hunting for them in every field. Dr. Hoy informs me that, near Racine, he observed, in autumn, a flock of black-hawks, (*Archibuteo sancti-joannis*,) twenty or thirty in number, to frequent a high knoll to which numerous meadow-mice had been driven by the inundation of the surrounding low-lands. This they visited morning and evening for over a month, during which time they appeared to feed upon nothing else than meadow-mice. One of them, shot late in autumn, was exceedingly fat, and had the remains of four full-grown arvicolæ in his stomach. Dr. Hoy estimated the number destroyed by the flock in six weeks, at over eight thousand. He says that they form the chief food of this hawk in the West, and that it should be regarded as a friend to the farmer, the more so as it does not make predatory descents upon the farm-yard. Arvicolæ are the legitimate food of the prairie rattlesnake, or massasauga (*Crotalophorus tergeminus*.) In many specimens of this snake examined, I have not found one, the stomach of which did not contain the remains of meadow-mice. The rattlesnake can readily enter their burrows, and is certainly more or less nocturnal; so that the arvicolæ, when out at night, fall an easy prey to this voracious reptile, which, though noted for its ability to endure wonderful fasts, even of a year or more, in captivity, is, nevertheless, a huge feeder naturally. I have taken the partly-digested bodies of five adult arvicolæ, with the remains of two small garter-snakes, and some birds' feathers, from the stomach of a rattlesnake; and have repeatedly found the remains of several mice, in various stages of digestion, in the stomach of one of them, showing that they had been caught at different times. And, I would here remark, that I have

little faith in the opinion popular among farmers, that rattlesnakes eat only at long intervals from choice. Observation indicates the contrary. Meadow-mice are also devoured by the common large-striped, or garter-snake, (*Eutœnia sirtalis*,) and are undoubtedly eaten by another garter-snake, (*Eutœnia radix*,) which is our most abundant reptile on the prairies. They are also found in the stomachs of the milk-snake, (*Ophibolus eximius*,) and of the large fox-snake (*Scotophis vulpinus*.) All the larger snakes probably prey upon them in other localities. The most abundant species of arvicolæ, in this region, are inhabitants of the prairie, and have less to fear from the small timber-loving carnivorous mammals, than those living in the woods. Minks, skunks, and weasels, however, when inhabiting the prairie, devour many; foxes, also, eat them, and prairie wolves dig open their burrows and feed largely upon them. Badgers, no doubt, also destroy many. As stated, in noticing the striped spermophile, that animal makes many a meal upon them, as well, perhaps, as Franklin's spermophile. Domestic cats hunt them eagerly, eating them in preference to house-mice. It is to be observed that the flesh of the arvicolæ is sweet and delicate, without the disagreeable flavor of the house-mice, being, in fact, quite palatable. Judging from the astonishingly savage and carnivorous propensities exhibited by some specimens, in confinement, it is highly probable that, where abundant, they may frequently devour each other. After the annual fires have burned the grass on the prairies, numerous nests of the arvicolæ may be found on the ground, the inmates of which, unable to escape, have often been killed, furnishing a feast to the many hawks, owls, &c., which flock to those grand barbecues.

In spite of all this destruction, arvicolæ are abundant on the wild prairie. With their exceeding fecundity, how much greater must be their increase in cultivated land, where most of their natural enemies are destroyed. Our farmers kill the small birds of prey with a zeal that would be highly commendable if exhibited in a better cause, while the man is rarely found who does not kill the harmless mouse and insect-eating snakes, with as much eagerness as he would destroy the really objectionable rattlesnake, which is the only poisonous reptile on the prairies of Illinois and other Western States.

Let one of our prairie farmers, who regard these pests as "inoffensive little mice that only steal a few kernels of corn," investigate their habits carefully for a year, and he will be very apt to conclude that meadow-mice are a kind of farm stock that are "hardy and excellent breeders," but rather expensive "to keep." It may be, he will think it best to forbid killing, too, on his farm, the prairie hawks, owls, and shrikes, as well as harmless snakes. This he will be still more apt to do, if he has observed, as I have, that, besides mice, the food of these is chiefly insects. I would ask any observing farmer if the ungrateful and foolish destruction of those friends of agriculture is not a disgrace to a community calling itself civilized and enlightened?

The protection of such of their natural enemies as are not themselves too mischievous, should be the first care of farmers injured by arvicolæ. Any dog, which can be taught to hunt them, will scratch and destroy great numbers. I have observed dogs, which were encouraged, to spend most of their time, day after day, in hunting their burrows, and thus quite ridding fields of them for the time. On farms, where there is no grain left out in autumn, they will collect under little bunches of hay placed for the purpose, especially if baited with an ear or two of damaged corn; and, by examining these occasionally, with the assistance of a dog, many may be killed. Any farmer with young sons who exhibit a predilection for the "chase," should furnish them with a lot of common mouse-traps to be bought at the cost of a few cents apiece; and, thus equipped, the juvenile "sportsmen" will often "bag" large quantities of this "game," and be doing far better, withal, than some of their older brothers, who, perhaps, are wasting more costly ammunition, meanwhile, in shooting useful birds.

To wage war effectually against these, or any other of the animals the depredations of which should be resisted, farmers must work together, all in a neighborhood, taking measures for one to destroy the injurious insects or mammals, and protect the reptiles, birds, and carnivorous quadrupeds, which are the enemies of the depredators on a small farm, if his neighbors on every side pursue an opposite course.

A little care will frequently prevent much of the destruction caused by arvicolæ. Farmers inform me that, by putting into long, rather than short shocks, the corn to be left out, it escapes much injury, these animals apparently foreseeing that it would not, in this form, afford them sufficient protection in winter. In preparing half-hardy plants for winter, in gardens infested by arvicolæ, straw should not be used. Inverted sods, placed over tender roses, &c., pegged flat to the ground, do not furnish the meadow-mice a resting place; and, as it is not the extreme cold that kills plants in winter, but rather the exposure to wet, and sudden changes in temperature, this method is often better, under any circumstances, than covering them with straw. Arvicolæ are always most injurious on farms grown up with weeds, which furnish them resting places and food, at times when they could not otherwise remain, as it is to be observed that they do not burrow on bare ground. Hence, small patches of grass, in large and well-cultivated fields, will always be found full of their burrows, in regions where they prevail. The greatest injury committed by them is the girdling of fruit-trees; and here their ravages may often be prevented merely by clearing away all grass and weeds from about the roots. But it must be remembered, that they will travel under the snow, on clear ground, to some distance from their burrows; and, therefore, if possible, no uncultivated spots should be allowed within several rods of the trees, on farms much infested by them. I have observed hundreds of apple-trees girdled, in a nursery kept free of weeds, but situated within three or four rods of unbroken prairie inhabited by these pests.

Wrapping the trunks of fruit-trees with strips of muslin, so arranged as to shed rain, may at times be advisable; the same cloth being applied every fall, and removed in spring, will last several years. It is said that neither mice nor rabbits will gnaw through it when thus applied; but dipping it in tar no doubt would be beneficial.

COMMON WHITE-FOOTED WOOD-MOUSE.

[PLATE X.]

Mus leucopus, RAFINESQUE.

DESCRIPTION.—Animals of this species vary much in size, adult specimens being from $2\frac{1}{2}$ to $3\frac{3}{4}$ inches in length. The length of the tail, as compared with that of the body, also varies, being usually, however, a little shorter. The colors of the upper parts also vary in different specimens and at different seasons. Length of a large female, in August, from nose to root of tail, $3\frac{3}{4}$ inches; tail, $2\frac{7}{8}$ inches; hind-foot thirteen-sixteenths of an inch. The upper parts are light brownish-yellow, with a stripe darker along the back. The yellow color is clearest on the cheeks and along the sides. The feet and entire under surface of the body are pure white. Other summer specimens are bluish-grey on the back. Upper parts, of a young specimen, of a uniform blackish ash-color, without any yellow. Though this may rarely be mistaken for the common house-mouse, which it somewhat resembles in form, it is at once distinguishable by its pure white belly and feet.

The white-footed wood-mouse is known under the names of "Deer Mouse," "Buck Mouse," "White-footed Field Mouse," and, in common with the "Wood Mouse," (*Jaculus labradorius*,) and "Jumping Mouse." It appears to exist throughout the wooded portions of the United States, generally, from the Atlantic to the Pacific. In this vicinity, the Mus leucopus appears to inhabit the timber only. I never observed one on the prairie. It is found in wooded farms, where it is more or less injurious to the farmer, carrying off and devouring grain, destroying various young plants, and occasionally doing much mischief by gnawing the bark of fruit-trees. On the whole, however, it cannot be considered very injurious. Though it may inhabit grain-fields in harvest time, it is decidedly a timber lover, and never breeds nor takes up its residence permanently in large fields, clear of trees, stumps, and logs. Its home is usually in an old stump or fallen log, under the bark of decayed trees, and sometimes in hollow trees, at a considerable height above the ground. It sometimes takes possession of deserted birds' nests, and occasionally builds in the branches of trees. Dr. Hoy informs me that he has seen several of its nests in Southern Wisconsin. They were usually placed among the thick branches of a thorn, at a height of 8 or 10 feet from the ground. The nests were composed of grass, and were of a globular form, the entrance

being a small hole on one side. I have also found nests on the ground, under logs, and once in August, found a female, about to bring forth young, in a nest of grass under a small block of wood, on a low river-bottom. I have not observed this species burrowing in the ground, and it appears rarely, if ever, to do so in the woods.

This mouse is sometimes gregarious, as many as a dozen having been found together in winter. I am informed of numerous instances in which several have been observed inhabiting the same hole in a tree with a family of flying squirrels. Neither species being at all pugnacious, they doubtless live together in harmony.

The white-footed wood-mouse feeds chiefly upon the leaves and seeds of various grasses, and other herbaceous plants, with nuts, acorns, and the seeds of basswood, maple, and other trees; grain is also eaten greedily by it in the fields. It lays up considerable stores of food for winter. Mr. Joseph Kennicott informs me that, in Western New York, he found within a stump in a clover-field, several quarts of clean seed of red clover, collected by a family of these mice. In storing up buckwheat, beech-nuts, and some other nuts and seeds, they strip off the shell, or covering to the kernel, and frequently a quart or two of the cleaned kernels of beech-nuts or various seeds will be found in their holes. Why this is done is not apparent. The mice would scarcely take so much trouble merely to save room occupied by the shells, and these fleshy kernels cannot keep as well when thus deprived of their natural covering.

This species is active in winter, like the rest of the genus, moving about a good deal on top of the snow, as well as below it, and sometimes travelling a long distance at this season. Mr. Laurence Koebelin tells me that, in cold weather, in December, he found one which had collected grass and formed a large nest in a pile of wood within two days after it had been cut.

The female exhibits much affection for her young. These, when small, I have always found attached to her teats, in which way she would carry them off, moving, unless chased, with great caution, as though she feared to injure them. A neighbor relates that, in turning over a log in the woods, he exposed one of these mice, which, instead of jumping off rapidly, moved slowly away along a small log, and was observed to have several young attached to her teats. Her movements being watched with interest, one of the young was seen to be brushed off and fall among the grass, the mother passing on out of sight. The young mouse left was quite helpless, and, continued to utter a low squeak. After a while, the mother returned to it, and though her movements could no longer be observed, the voice of the young mouse ceased, and, upon examination of the spot, it was found to have disappeared with the mother. It is not to be supposed, however, that the young of this mouse are attached to the mammæ of the parent like those of the opossum.

Caged specimens do not eat flesh, and are not at all pugnacious. One kept for some time was very timid, did not bite when taken in the hand, nor did it become irritated when teased; yet remained

discontented with captivity, showing no inclination to burrow in the earth at the bottom of its cage. When liberated upon the floor, it moved by sudden springs, holding high its long tail.

This species is active on the ground, and climbs readily. It dreads the usual enemies of small, timber-loving quadrupeds, though being nocturnal, it probably escapes the attacks of hawks. It must be much preyed upon, however, by owls; and weasels are said to be among its worst enemies. I have in several instances found the milk-snake (*Ophibolus eximius*) under logs and in old stumps, in suspicious proximity to the nests of this mouse; and other snakes, inhabiting the woods, also probably devour it. That it has numerous enemies is shown by its not increasing more rapidly—since it is a prolific species. I have usually found from four to six young in a nest; and there are two or three litters a year.

This is a beautiful little animal, possessing a graceful form and delicate colors, and would make a very interesting cage pet.

WHITE-FOOTED PRAIRIE-MOUSE.

[PLATE XI.]

Mus bairdii, HOY and KENNICOTT.

DESCRIPTION.—Length of the adult male from nose to root of tail, $2\frac{7}{8}$ inches; tail, (vertebræ,) $1\frac{7}{8}$ inches; hind-foot, $\frac{3}{4}$ of an inch. Head and body of a large male, $3\frac{3}{4}$ inches; tail, 2 inches. In another specimen, the head and body, 3 and three-sixteenths inches; tail, $1\frac{3}{4}$ inches. In spring, the hairs on the upper parts are plumbeous at the base, tipped with ashy and yellowish-brown; a few longer hairs, entirely black, interspersed. The tips of most of the hairs deepen into black along the back, giving a broad, black stripe, when the hair lies flat. In some specimens, this stripe is not so dark as in others, but is quite distinct in all, while in some it is pitch-black. On the upper lip, and entire under parts of the body and legs, the hairs are plumbeous at the base, tipped with pure white. The cheeks and lower edges of the color of the upper parts, are yellowish, forming a border between the colors of the belly and back. There is a distinct line of demarcation between this yellow border and the white belly. On each side of the root of the tail is a bright brownish-yellow spot, formed by the termination of the yellowish line on the side. The hairs immediately about the root of the tail are ashy-brown. The ears, upper part of the tail, and a distinct spot on the top of the fore-foot, are brownish-black. The nails and toes of all the feet, and the tops of the fore-feet, back to the blackish spot, are pure, creamy-white. In some specimens, the hind-foot is white nearly back to the heel; in others, it is ashy-brown along the top, and white at the sides. The white of the under parts of the fore-arm extends sometimes quite, at others nearly, around on top, behind the blackish spot. The ears are as well clothed, and with as long hairs, as those of summer specimens of Mus leucopus; and the edges are whitish. The incisors are yellowish, those in the upper jaw darker than in the last-named species. The whiskers, situated anteriorly, are white, and those further back, entirely black. The comparative number of white and

black whiskers varies much in different specimens. When young, the upper parts are dark ashy-brown; darker along the back, and faintly tinged with yellowish on the cheeks, sides, and flanks. Like the preceding, this species varies a good deal in size, and somewhat in the shades of coloring. This mouse may be distinguished at once from its nearly allied congener the Mus michiganensis, of Audubon and Bachman, which species Dr. Hoy has detected inhabiting the open woods near Racine, by its pure white belly, and by the distinct line of demarcation between the color of the belly and the yellowish-brown border on the sides. It will be very generally mistaken for the Mus leucopus, which it much resembles in form and color. Upon comparison, it may be readily distinguished, however, by its smaller size, much shorter tail, darker color, with usually a black dorsal stripe, more distinct than that in the Mus leucopus, and by its having the upper part of the tarsi ashy-brown instead of pure white, as in that species. Moreover, the one always inhabits the prairie, and the other the woods.

The Mus bairdii is found abundantly on the prairies in Northern Illinois and Southern Wisconsin; and Mr. Samuel Arny sent me a number of specimens from Bloomington, McLean county, Illinois, where, he informs me, it is common. It will probably be found in the neighboring prairie regions, where it is strictly an inhabitant, and replaced the Mus leucopus. I have never observed it in the woods, even near prairie fields in which it abounds. In Northern Illinois and Southern Wisconsin, this is a much more numerous species than the Mus leucopus. It is confined only to high ground, and is most abundant in cultivated fields.

Not having, on the prairies, the shelter found by its timber-loving cousins, in old stumps and trees, this species digs burrows. These are rather simple, with few or no side-passages, and often with but one entrance, the depth and extent being variable, but never great. The nest is small, composed of soft grass, &c.; it is spherical, and the small internal cavity is entered through a narrow opening on one side. In cultivated fields, the burrows are frequently dug at the roots of fruit-trees, the bark of which is often gnawed, sometimes causing great injury. In nurseries, fruit-trees are often taken up and "heeled in;" that is, laid down close together, with the roots placed in a trench, and then covered in such manner that they are kept safely in a very small space, and can be readily pulled out when desired. The loose earth among the roots of these, offers an inviting habitation to the mice; and, in nurseries infested by them, they will be found burrowing in almost every lot of trees thus buried, where they feed upon the bark of the roots, and thus cause serious damage. In the fall, they are often found in corn-shocks, making a nest among the stalks, though they do not so often burrow under these as the arvicolæ. But, during winter, they may be tracked in corn-fields from their burrows to the neighboring corn-shocks, which they have visited for food. In spring, the young are always produced in burrows. During the summer, however, they are occasionally observed in nests, under bits of wood or bunches of hay, on the surface of the ground. In autumn, I have found nests of the young in small burrows only a few inches below the surface,

or under an inverted sod. I have never observed more than one pair of adults occupying the same burrow; and, unlike the Mus leucopus, this species never appears to be gregarious.

This mouse must be very prolific. I have found the young in March and April, and observed two females, each with five young, apparently but a few days old, about the 10th of November, while they are found in every intervening month. In nearly every instance within my observation the number of young produced at a birth has been five. I once found six, and have at times, though rarely, seen three or four. The young are found attached to the teats, as in the species last described; and a female was seen to carry five for several rods in this way, jumping along rapidly, despite their weight. As soon as they are able to take care of themselves, the young leave the mother. In summer, I have several times found one apparently but a few weeks old, living alone in a nest made by himself. In spring, I have always found the old male living with the female and young; but during the summer, I have sometimes observed the male leading a solitary life, and the females and young in burrows by themselves. The food of this mouse, on the prairies, appears to be herbaceous plants, with their seeds; but I have been unable to see that it ever digs for roots. It is interesting to observe that this, like the Mus leucopus, seeks its food on top of the ground, running on the snow in winter in search of seeds, and collecting them in autumn instead of roots, when it travels as often by springing over the grass as by running through it, while the arvicolæ, both in summer and winter, dislike to leave the shelter of the herbage or snow, never being seen to travel over the grass, but always in runways so constructed as to afford concealment by grass or leaves; and their food consists largely, if not chiefly, of roots dug out of the ground. Were the Mus bairdii an inhabitant of the woods, it would doubtless be to some extent arboreal, which the arvicolæ never are. This mouse probably feeds more or less upon insects, as it is carnivorous in captivity; though some specimens are much less so than others. On one occasion, I captured a pair with five young, and placed them all in a cage well supplied with various kinds of vegetables and grain. The next day, several of the young were killed and eaten, and in two or three days, they had all disappeared. Shortly afterwards, the male, which had been slightly injured, was found dead, and partly devoured by his rapacious spouse. After this, I fed my specimens with meat, as well as grain, which they ate; and, as long as they were supplied with it, they lived together harmless; but no sooner was this withheld, than the old ones, both male and female, devoured their young. Though all are more or less carnivorous, they are not generally so blood-thirsty as to devour each other or their young, when not supplied with flesh. Two, placed together in a cage, and observed carefully for several days, were never seen to fight, even when deprived of animal food. I several times noticed that, when one of these would pull a kernel of corn from the ear, his companion would also seize it with his teeth, and thus each would endeavor to draw it from the

other, standing erect upon their hind-feet, pushing with their fore-paws, and squeaking loudly. When one finally got it away, he would run to a corner of the cage and turn his back, to conceal the food as he ate it; the other sometimes following, but without ever offering to strike or bite. Caged specimens are very timid; and when teased, by having a stick thrust at them, they exhibit no pugnacity, and cannot be induced to combat or cry angrily; and when taken in the hand, they seldom attempt to bite.

I placed a female with five young, but a few days old, in a cage, and observing that six of the mother's mammæ had been sucked, I placed another, taken from a younger litter with her, which, to my surprise, she adopted; and several weeks afterwards, they having in the meanwhile taken a journey of many miles, I heard that this interesting little family, including the changeling, were all alive and well. This old female constructed the usual globular nest of the cotton and grass placed in the cage; and, upon looking into this, I found the young attached to her teats in every instance, except when I examined immediately after she had been out to eat, and before they had resumed their accustomed places. It is only when they are quite small, however, that the young remain so constantly attached to the mammæ.

In eating, this species stands on the hind-feet, holding the food in the fore-paws, which are used very readily as hands. It often sits erect, and cleans its fur with the fore-feet and tongue, stroking the fur with the feet as if to smooth it. In digging, the fore-feet are used with astonishing rapidity, the earth being thrown back between the hind-legs, which are stretched apart with the pelvis raised, to admit the passage of the earth. The voice is very soft, low and clear, and is not often heard. Slight as their incisors seem to be, I have known both this and the Mus leucopus to cut through the shell of a large hickory-nut, the specimens of this species having had no opportunity to see a nut before. This, like the preceding species, is strictly nocturnal, neither of the two ever being found moving out voluntarily by day; and, as observed in captivity, they shun the light, remaining quiet during the day, and becoming active at night.

This mouse is accused of digging up seeds and grain in the same manner as the arvicolæ, which may be true, but better evidence is wanting to sustain the accusation.

LONG-TAILED JUMPING MOUSE.

[PLATE XI.]

Jaculus labradorius

DESCRIPTION.—This Jaculus labradorius, with several allied species, differs materially from the true mice in form and habits. It is about 2½ inches long, with the tail often twice that length, and always much longer than the body;

the hind-foot, from the heel to the end of the longest toe, is nearly 2 inches. At the tip of the tail is usually a pencil of long hairs, though this is wanting in some specimens. The body is of a dark-brown above, yellowish-brown on the sides, and white, or at times rusty-white, on the under surface. The fore-legs are small; but the hind-tarsi are very long, with the legs and thighs large and muscular; which peculiar structure enables this little animal to take leaps of almost incredible length. It travels in this way so rapidly that a man must run fast to overtake it. I am informed that, when alarmed, it has been seen to spring 8 or 10 feet at once. At times it travels by these long leaps, when not disturbed; but it may also be seen walking or running on all four feet.

This animal is known as the "Long-tailed Deer Mouse," "Fob-tailed Mouse," "Kangaroo Mouse," "Jumping Mouse," "Buck Mouse," "Wood Mouse," and other names, common also to the Mus leucopus, from which it is usually distinguished by the prefix of "long-tailed," or "jumping." It exists probably in the entire northern part of the United States, as well as further to the northward. In this vicinity, it is a much less abundant species than the Mus leucopus. It is not very prolific, and is nowhere numerous. In Northern Illinois, it is found in the deepest woods, as well as in cultivated fields, and on the prairie at a distance from any timber. In the woods, it is often found nesting in situations similar to those occupied by the Mus leucopus. It cannot climb, but crawls up the inside of hollow trees to a considerable height from the ground, and is sometimes found nesting in them; but its nest is often discovered under the bark of rotten trees or stumps; and, though not much noticed when inhabiting these situations, it appears frequently, if not generally, to live in burrows in the ground, as it nearly always does in the fields, and on the prairies, of course. It digs readily. Its burrow in summer is not deep, and the nest is sometimes found in a tuft of grass above the surface, or under an inverted sod. In cultivated fields, it lives under fences, and, like the mice and arvicolæ, takes up its abode in grain that has been cut and left standing out.

The food of this species appears to consist chiefly of herbaceous plants, with their seeds, and the seeds and nuts of trees, when it inhabits the woods. In cultivated fields, it devours grain, of which it has sometimes been observed to collect stores in its burrows. But it does not appear to be very injurious to the farmer; and, as it produces but few young, and has numerous enemies, it will probably never increase so as to become a source of serious damage.

The jumping mouse is so generally confounded with the Mus leucopus that its habits are seldom correctly known among farmers. It is commonly believed to be active in winter, laying up a store of provisions in autumn for consumption at that time. Nuts, grain, and seeds, indeed, are found in its burrows, but they are collected, apparently, at all seasons, as in the case of the prairie-squirrels. That this animal hibernates is certain. Godman says that, "at the commencement of cool weather, or about the time the frost sets in, the jumping mice go into their winter-quarters, where they remain

in a torpid state." Dr. Hoy informs me that, when he was a boy, in digging out a rabbit in winter, he found a pair of this species in a state of profound torpor, exhibiting all the phenomena of perfect hibernation. They were in a large nest of leaves situated two or three feet below the surface. Audubon and Bachman, ignoring the statement of Godman, say it is doubtful whether this species hibernates. But the observations of so reliable a naturalist as Dr. Hoy are enough to settle the question, even if we discredit Godman's statement, which I see no sufficient reason for doing.

The jumping mouse is nocturnal, but may be regarded as less completely so than the white-footed mouse, as it has been occasionally seen moving out voluntarily by day. It produces only from two to four young at a birth, and, being a hibernating animal, probably not over one or two litters in a year.

PRAIRIE MEADOW-MOUSE.

[PLATE XII.]

Arvicola austerus, LE CONTE.

DESCRIPTION.—Length of head and body of old male in November, 4½ inches from nose to root of tail; tail, (vertebræ,) 1¼ inches; hind-foot thirteen-sixteenths of an inch, from heel to tip of longest toe. On the back, the hairs are deep blue-black at the base, then ringed with cinnamon-brown, and tipped with blackish, a few long hairs, entirely black, interspersed; on the head and along the back, the color is darker. Low on the sides and cheeks the hairs are all tipped with cinnamon-brown, without rings, as they are on the belly also, where they are shorter and thinner, and of a bluish-grey color at the base, thus leaving the belly bluish-grey, tinted with cinnamon. Tail and feet, thinly clothed with short hairs; tail, brownish-grey beneath, blackish above; feet, greyish; whiskers, shorter than the head, some entirely black, others white, with black roots; incisors, clear light lemon-color. The old male in spring, differs from the above, in having less black along the head and back, with very little cinnamon on the belly, while around the root of the tail there is a spot of dark-cinnamon. In this species the belly is usually more or less colored with cinnamon. Summer specimens from Wisconsin have the hair on the belly all tipped with light rusty-yellow. The young are very dark above, with more distinct cinnamon-color on the belly in the young of some specimens than in the adults.

On the prairies in Northern Illinois and Southern Wisconsin, the Arvicola austerus exists in greater abundance than any other native mammal, and far exceeds in numbers the other species of arvicolæ found here. The extent of its distribution is not yet known, but it will probably be found throughout the neighboring prairie regions. It never has, within my knowledge, been found in the woods. It frequents both dry and wet land, preferring the latter. In summer, these animals inhabit low, wet prairies, in great numbers, digging

burrows and forming nests in them, as well as on the ground among the grass. In autumn, they retire to higher ground, to spend the winter, being driven out of their summer homes by the heavy fall rains. Their winter burrows on the uncultivated prairie are often in old ant-hills, or, if not, the earth thrown out of them forms little hillocks. They are not very deep, seldom over six inches or a foot, but are remarkable for the numerous and complicated chambers and side-passages of which they are composed. In one of these chambers, considerably enlarged, is placed the nest, formed of fine, dry grass. It is globular, from four to six inches in diameter, and with but a small cavity in the centre, which is entered by a very narrow opening on one side. This burrow and nest are occupied in winter, and in it at least the first litter of young is produced in spring; but, in the summer and fall, these meadow-mice may be found in similar nests in the grass above ground, in which the young are often, if not usually, brought forth. Nests formed under the snow in winter are also occupied by them. From the burrows, innumerable runways traverse the neighborhood, intersecting those from other burrows, thus forming a complete net-work so that often scarcely a square yard can be found in an acre not crossed by one or more of these tracks. The runways of one pair may sometimes be traced five or ten rods on every side. These roads are not only formed for use in winter, when the ground is covered with snow, but are also employed as highways in summer. They are made above ground, by pressing down and gnawing off the grass, and the earth is often worn quite smooth and bare in those most used. The inhabitants can travel easily along them at all times, in search of food, being well concealed by the overarching grass. In winter, these paths are formed on the ground, under the snow, as well as in the grass. The mice do not inhabit prairie pastures, where the grass is eaten close and affords them no cover.

This species is exceedingly prolific. Five young are most commonly produced at a birth; but the number varies from three to six. They are brought forth from early in April till October; and, in one instance, I found suckling young in the middle of November. Of the number of litters produced in a year, I am unable to form a certain estimate. The young, though not generally found attached to the mother's teats, as is the case with some other species, are at times observed in that situation; and a female was seen to carry three half-grown young a distance of several feet in this manner. As soon as they are able to take care of themselves, they leave the mother. In summer, the old males do not live with the females and young, but are generally with the females in spring, although an old male has been found in November with a female and her sucking young.

In their home on the prairie, the natural food of these animals is the grasses, with their roots and seeds, as well as those of some other plants. Various roots, indeed, form the largest portion, and usually comprise the store of provisions collected for their winter subsistence.

Mr. Job Galloway, of Northfield, informs me that, while mowing in a low prairie, inhabited during summer by this species, he observed a small garter-snake passing rapidly through the grass, with a young meadow-mouse, partly swallowed, in its mouth. The low squeak uttered by the latter attracted his attention. Presently, an old meadow-mouse emerged from the tall grass in pursuit of the snake. Stopping an instant, as if to listen for the cry of her young, she again pursued, and finally overtook the snake, which she unhesitatingly attacked. The snake stopped, disgorged his prey, and defended himself by striking at his assailant, which appeared to be beating him, when he was killed by Mr. Galloway.

Upon examining, in November, the burrow of a pair of these meadow-mice, situated on the wild prairie, I found the excavation to have been recently enlarged. The nest was placed near the centre of the burrow; and at one side, and in the deepest part of the excavation, was the store of winter provisions. This consisted of 5 or 6 quarts of roots, chiefly the round tubers of two species of spike-flower, (liatris,) which grow abundantly in the vicinity, with a few roots of helianthus, and of various grasses, and several bulbs of wild onions. By tracing carefully the numerous and extensive paths which run in every direction from the burrow, I observed where the inmates had procured their food. The large fleshy root of the rosin-weed, or compass-plant, (*Silphium laciniatum*,) appeared to have been eaten very freely in autumn, at least. The root of this interesting prairie plant is sometimes a foot in length, and an inch or two in diameter at the top. To obtain it, they had burrowed down alongside, quite to the bottom, eating out the entire soft parts. Though so much eaten, none of it was found in their burrows.

The prairie meadow-mouse is not a gregarious animal naturally; and, when more than one pair is found together in fields, it is where they have all been alike attracted by the food and shelter offered by the situation. Though their burrows are sometimes quite near each other on the prairies, this is only when they are very abundant. Two pairs never occupy the same hole.

In cultivated fields, the habits of this species are somewhat changed. When corn-fields are near, they flock to them in autumn in great abundance; and, wherever a corn-shock is to be found, a pair takes possession of it, digging under it a more simple burrow than in the prairie or meadows. Besides the nest in this burrow, another is formed among the corn-stalks, above or at the surface of the ground, and is chiefly occupied during mild weather, the inmates retiring to the burrow in extreme cold. Frequently a corn-shock will be temporarily inhabited by those having burrows at some distance. A quantity of corn is carried into the winter burrow under the shock, in spring, as well as in autumn, in compliance with the inclination to collect stores of food at all seasons.

By looking in the fields the day next following a fall of snow, in November, I had an opportunity to observe something of what these arvicolæ had been doing in the night. As there was scarcely an inch of snow, they had not generally travelled under it, as they do

when it is deeper, by pushing it aside, mole-like, at the surface of the ground, but had moved on top, leaving their plain tracks. In a field containing shocks of corn, they could be traced not only to the shocks they inhabited, but to all others. Some were traced to burrows into which they had carried large stores of corn taken from shocks several yards distant, and others could be tracked for ten or fifteen rods across the field, to where they had entered the grass at the edge of the prairie, having come from their burrows to feed upon the corn. Wherever there was grass or weeds, though only two or three inches high, they had moved under it, in preference to going on top; and even on clear ground, where the snow was drifted to the depth of two or three inches, they had passed beneath, leaving it unbroken above. This illustrates, not only the smoothness of their gliding motions, but also their disinclination to travel by springing over high objects. In moving over ploughed ground, they did not jump clear across from one ridge of the furrow to the other, but ran part of the way down one side and up on the other. When travelling on the open ground, they moved by short jumps of from four to eight inches. Sometimes, they ran or trotted, appearing always to move in this way in their runways in the grass; and, in fact, this is the gait most natural to them. When caged specimens are liberated on a smooth surface, they glide off at this gait with great rapidity, never jumping, but rather running around small objects; though, on the whole, they show more activity than their forms would seem to indicate, springing readily to some distance when so disposed.

I have often kept specimens of this species in cages for a short time. They soon became reconciled to confinement, and took food from my hands. When placed in wooden boxes, they generally made no attempt to gnaw out, though, when they did begin to use their teeth in this manner, they would sometimes cut their way through an inch board.

In confinement, they ate all kinds of grain and vegetables, including the bark of the apple, pine, and other trees. The stems and leaves of grasses, with pansies, pinks, and other plants from the garden, were also eaten indiscriminately. They also managed to gnaw through the shells of hickory-nuts, though such a thing as a nut could never have been seen by them before. Raw, fresh meat of any kind was eagerly devoured. In short, they were omnivorous. The amount of food consumed by some specimens was astonishing. Three ate, in twenty-four hours, besides other food, the germs from all the kernels on a good-sized ear of corn. At another time, a piece of carrot, measuring over a cubic inch, was eaten by two specimens in one night; though they ate corn, grass, and meat the previous and following days. They drank a good deal of water, soon perishing when left long without it, or some moist food. In drinking, they sometimes lapped, but oftener thrust the nose into the water and moved the jaws as in masticating. When eating, they grasped the food in their fore-paws, or sometimes held some particles in one paw, while standing upon their hind-feet, not erect on the

haunches, but resting on the foot, (tarsus,) with the back-bone arched, and the body leaning forward. This position was also frequently assumed when they were not eating, and they often stood quite erect, upon the tarsi, or toes, alone, to look about, or to examine anything held above them. In running, the toes only were placed upon the ground. The fore-paws are used as hands with all the facility of a squirrel, the food being grasped in them, and turned about at pleasure. Upon holding a stem of grass near one, he seized it with his paws, and, biting off small pieces with his incisors, chewed and swallowed them rapidly. As I pulled it gently, he grasped it more firmly ; and, as I continued to pull, he reached up an inch or two, and cut off the stem with his teeth. A piece of the dry, outer covering of this getting into his mouth, he held that which he was eating from in one paw, and with the other quite readily drew out the unpalatable part, without ceasing to masticate. When an ear of corn was placed in the cage, each one would seize a kernel with his incisors, and, bracing his feet against the ear, wrench it out by pulling to one side. In eating, the food was cut into very small pieces by the incisors, before being ground by the molar teeth. They sometimes attempted to crush pieces of meat or vegetables, half the size of a pea, with their molars, but, taking them into their paws again, would always cut them smaller with their front teeth. When the bottom of the cage was filled with earth, they would soon burrow in it. In digging, they would scratch rapidly with the fore-feet several times, and then throw back the earth to a greater distance with the hind-feet. The nose was much used to push the dirt aside, which was also frequently loosened with the teeth. As the hole grew deeper, and was dug horizontally, they sometimes turned over on the back, to dig in that position. In removing the earth from a burrow of some extent, they came out backwards, scratching back the earth, with both hind and fore-feet, as they came.

The ferocity and exceedingly carnivorous propensities exhibited by some specimens of this little rodent are truly astonishing. Adult specimens recently captured and placed together often kill and devour each other, mothers even eating their young. One evening I placed in a large cage two old males taken in different burrows. In the course of the night, much fighting and crying was heard, and the next morning one was found to have been killed and partly devoured by his companion. The other was supplied with corn and fresh beef, both of which he ate ; and in the course of the forenoon, a half-grown house-mouse was placed alive in the cage. This, without provocation, he at once attacked, as if in great rage, uttering his usual cry of anger, with his hair erected and bristling. In fighting, he sprang upon the mouse, striking with his fore-feet, at the same time snapping quickly with his teeth, and then springing nimbly back. Finally, he seized the mouse by the rump with his incisors, and thus broke his back-bone. After this, the latter, which had fought as well as he could, ceased to resist, when the meadow-mouse, catching him in his teeth, threw him forcibly to

some distance, and continued to strike, bite, and toss him about until he was dead. His anger then appeared to subside as rapidly as it had risen, and a few minutes he was observed placidly eating corn. The old males were always very pugnacious, biting and striking at anything thrust towards them. When much teased in this way, they sometimes turned on their backs, snapping with their teeth, and striking with all four feet. When enraged, they uttered a low, harsh, creaking note, resembling that of a very young puppy. If hurt, their voices were clearer and sharper. Sometimes they chattered their teeth in anger. The females were not so pugnacious, and were more silent; seldom fighting or crying out in anger when teased. They were equally as carnivorous, however, as the males. Like most arvicolæ, this species takes to the water boldly, and swims and dives readily.

WOOD MEADOW-MOUSE.

[PLATE XII.]

Arvicola scalopsoides.

DESCRIPTION.—Head and body of the adult male, in November, nearly 3½ inches long; tail, nearly ¾ of an inch; hind-foot, ⅝ of an inch. Head, large; snout, blunt; ears, concealed by the fur; eyes, very small; fur on the back, soft, glossy and smooth; hairs, plumbeous at the base, broadly tipped with dark-brown on the back, and slightly tipped with white and reddish-brown on the belly. Young, color like that of the adult. This species is readily distinguished from the other arvicolæ found in this vicinity, by its smaller size, glossy fur, large muzzle, small eyes, and very short tail. It is common in the woods in Northern Illinois and Southern Wisconsin, where it is less abundant, however, than the two preceding. This is probably the species mentioned under the name of Arvicola riparius, by Dr. Plummer, in Silliman's Journal, as existing in Wayne county, Indiana.

Unlike the two species last described, this, so far as I have observed, lives exclusively in the woods, or in fields surrounded by timber, though it becomes more numerous in the clearing and prefers high ground. Its home, as noticed here, is under the leaves, and its mode of life brings strongly to mind the Sorex dekayi, with which, in fact, it is found in every locality in the woods where I have seen that shrew. Its runways are similar to those of the shrew; and I am inclined to think the tracks of the latter are much used by it. It is probable that the arvicolæ may drive off the shrews, and take possession of their ready-made highways, as they are very pugnacious, and apparently able to beat the other, their eyes giving them much advantage over their sightless adversaries. They always travel under the leaves, apparently; and, in turning over logs, beneath which were their nests, I have observed that, in endeavoring to escape, they ran *under* instead of *over* the leaves,

even where there were no paths; nor did they stop to hide in them, but ran off to some distance. When placed on the snow, it attempts to burrow into it, instead of running on top. This species is also more diurnal in its habits than the Arvicola austerus.

I have always found the nest of this arvicola under logs or stumps, whether that of the female, with her young, in summer, or pairs in their winter-quarters in November. Those observed in fields always burrow under stumps or fences, instead of in the open ground. The nest in the woods is composed of leaves cut up into small fragments with fine grass. It is not placed in the under-ground burrow, but on the surface, being well protected by the log or roots above. The burrow is extensive, but not exceeding the length of the log or stump covering it. Numerous paths run in every direction from the burrow, under the leaves; they occasionally pass beneath the surface, and shallow holes are dug, as if in search of food, the earth being thrown out of these, whereby they are easily distinguished from the tracks of the shrew, which presses the earth aside in forming its track. By following these paths, I have observed where the meadow-mice fed upon the roots of grass and various other plants, often digging down several inches for them; and I have in several instances found the bark gnawed from the roots of briers, &c. Hickory-nuts, hazel-nuts, and acorns were also found partly eaten in their tracks. The acorns of the burr-oak and white-oak formed most of the stores collected in such burrows as I have examined. In one instance, I found the nest of a pair of this species in autumn, in part of a burrow occupied at the same time by chipmucks, and in which the latter had collected large stores of acorns and nuts.

This is the smallest of our rodents, and, for its size, I know of no mammal more pugnacious than the males, at least. I placed one in a box with a specimen of Sorex dekayi, which it at once attacked. The shrew was courageous and never retreated, neither did he attempt to pursue the other to any distance. The meadow-mouse acted on the offensive, and made unprovoked attacks, the cage being large enough for both. He approached the shrew cautiously, and when within two or three inches sprang upon him, biting and striking with his feet, and then jumping back quickly, in fact fighting in the same manner as the Arvicola austerus. When he came near, and the shrew made the first attack, the meadow-mouse would rise upon his hind-feet, and strike with his fore ones, and snap rapidly with his teeth. Had the fight been allowed to continue, it is probable that the shrew would have been beaten; for, though much the stronger, and doubtless able to kill the meadow-mouse readily, if he could grapple with him, the latter was enabled, by his sudden springs, to inflict severe wounds, and exhaust his adversary, without being much hurt himself. The shrew constantly uttered his sharp, bird-like twitter; but the meadow-mouse fought in silence. This species, in fact, is always much more silent than the two preceding. When hurt, however, it utters a low cry, softer and shorter than that of the Arvicola austerus. When a caged

specimen was teased, it would become enraged, and bite fiercely at anything thrust at it.

Caged specimens of this species show less inclination to burrow than the two preceding. In eating, they do not hold the food up from the ground, but grasp it in the fore-paws, as it lies upon the surface, sitting meanwhile upon the hind-feet, yet resting in part upon the fore ones also. Is not this posture the necessary result of their inability to stand erect in their leaf-roofed highways? In digging, the snout is much used to thrust aside the earth, and they sometimes "root" with it, like hogs, in search of particles of food slightly buried in the bottom of the cage, and often eat these without taking them in their paws at all. My specimens were fed upon acorns and corn, and the entire grain of the latter was eaten. But they had all been taken in the woods, and could never have seen this food before, and were doubtless ignorant of the method adopted by their cultivated cousins, living in the prairie corn-fields, which, with a very objectionable refinement of taste, eat out only the germ, and thus destroy far more than they would by eating the whole grain. My caged specimens refused to eat flesh of any kind. This species, indeed, is probably less carnivorous than the Arvicola austerus.

I am not informed as to the extent to which this meadow-mouse is injurious here, but in timber-farms it is doubtless as great a pest—and in the same manner—as the prairie species, when equally abundant. Stumps left in fields form favorite retreats for them, from which they are not easily dislodged.

LONG-HAIRED MEADOW-MOUSE.

[PLATE XIII.]

Arvicola riparius.

Description.—Length of head and body of the male in spring, 4 inches; tail, (vertebræ,) 1 inch; hind-foot, ⅝ of an inch. The general color of the upper parts resembles that of Arvicola austerus, but there is no black tip to the tail. The belly and under part of the tail are greyish-white. The incisors are bright-orange. The fur on the back, as well as on the belly, is much thicker and longer than that of the Arvicola austerus. This species may readily be distinguished from the preceding, by the different color of the teeth and under parts, and the much longer tail and fur. The color of the back varies sometimes, as it does in a specimen for which I am indebted to Professor A. Winchell, of the Michigan University, the back of which is of a rusty-brown color; and Dr. Hoy informs me that he has seen specimens with similar coloring.

This meadow-mouse abounds in Northern Illinois and Southern Wisconsin, and has been taken in Michigan. Dr. Hoy informs me

that he met with a few specimens near Lexington, in La Fayette county, Missouri. The Arvicola riparius is far less abundant in this vicinity than the preceding. Among twenty or thirty specimens of the Arvicola austerus, taken in various localities in the fields and on the prairies, in autumn, there were but two or three of this species. Dr. Hoy informs me that, near Racine, they abound in meadows, in the woods, burrowing under stumps and trees, in situations never inhabited by the Arvicola austerus, as well as on the prairies; but, so far as has been observed, this species does not inhabit heavy timber. It appears to be a prairie animal, though sometimes found thus living in timber-lands. Inhabiting both high and low-land, yet it shows no preference for wet places, as does the species last described. It is not numerous in fields in which the Arvicola austerus abounds, though existing in the greatest abundance elsewhere. Considering this, and the greater strength and pugnacity of the Arvicola austerus, it seems probable that the latter drives it off. The burrow of this species is very different from that of the preceding, being simple and of slight extent. It appears also to be more gregarious. I have, indeed, several times found a half dozen or more inhabiting the same corn-shock or potato-heap. In captivity, this animal is less pugnacious than the Arvicola austerus; but it is much more noisy also, crying out almost continually, when several are eating together, or at all disturbed. The voice is a harsh creaking squeal. The food and habits, so far as observed, are, with the exceptions mentioned, the same in this as in the preceding species.

MUSKRAT.

[PLATE XIV.]

Fiber zibethicus, LINNÆUS.

DESCRIPTION.—A full-grown muskrat is about 15 inches in length, from nose to root of tail, and the tail 10 inches. The body is heavy, eyes small, ears concealed, and incisor teeth large; the tail large, nearly naked, and flattened laterally; legs, short, hind-feet, with the toes flattened and partly palmated; beneath the long hair is a coat of dense, soft and very warm fur; color of the body, ashy-brown above, ashy on the under parts.

The muskrat, or "Musquash," abounds in the greater part of North America, though not in certain of the Southeastern States. It is found northward to the Polar Sea. It is strictly aquatic, its stout tail and muscular hind-legs, being provided with broad feet and toes, furnish it efficient means of locomotion in the water, while its thick, downy fur protects it from the wet. On land, its movements are as awkward as those of a duck. It naturally seeks its food in the water, away from which it never takes up its abode.

Though frequently seen abroad by day, muskrats are nocturnal, moving mostly by night. They are to some extent gregarious, a number uniting to make houses and burrows. In most localities, where the situation admits of it, they construct houses in the water with much skill; in marshes and ponds, or along sluggish streams, when protected from the current, they form large piles of sticks, leaves, rushes, carices, and various aquatic plants, the whole well stuck together with mud, and having a comfortable chamber in the centre, entered only through a hole from below the surface of the water. This is the winter home of muskrats, more than one pair usually occupying the same nest. Near by, in the bank, is generally a burrow, with numerous and extensive galleries, in which they take refuge when driven from their houses in winter, and in which the young are commonly produced. These burrows, like the houses, always have the entrance under water.

The muskrat is active in winter, seeking his food under the ice, and carrying it into its burrow or house to be eaten. Though roots are sometimes found in a nest in winter, they are only such as have been recently brought in, no considerable stores of food being collected. The food, in winter, appears to consist of roots of aquatic plants. In summer, it also feeds upon the leaves of various plants, as well as upon muscles, (*Unio anodonta* and *U. plicatus*, etc.,) of which they consume great quantities in some of our rivers. Collecting them from the bottom, it carries them in its teeth to a log or stone, where, sitting upon its haunches, and grasping them in the fore-paws, it opens the shells with the incisors as skillfully as it could be done with an oyster-knife. In this way, large piles of shells are collected around stones and logs, by examining which the conchologist may often find rare species, brought from the mud by these animals which have been more successful collectors than himself. I have observed that those species with thin shells are most sought for, and have often found large specimens of Unio plicatus unopened among the piles of empty shells, the muskrat apparently considering them not worth the trouble of gnawing apart the valves at the back, in which manner the heavy shells are sometimes opened.

Muskrats are seldom seriously injurious to the farmer's crops, though they are occasionally mischievous in fields adjoining water inhabited by them. I have observed ears of corn dragged to their nests, and they sometimes make great havoc in vegetable gardens where they show an especial fondness for parsnips and muskmelons. Their greatest injury, however, is committed by burrowing in embankments formed to confine water, mill-dams being often much damaged in this way. They also frequently destroy artificial ponds for collecting ice. Except in eating mollusks, and occasionally a dead fish, I am not aware that this species departs from a vegetable diet.

This species is pugnacious, and resists courageously when attacked. The males sometimes have fierce battles, and trappers state that the tail is occasionally mutilated, or cut entirely off in these combats.

The voice is a sharp squeak, and some hunters will call the males within shooting distance by imitating it. From five to seven young—more or less—are produced in April or May. In this region, at least, the muskrat's worst enemy is the mink, which, swimming and diving readily, not only enters their burrows and houses, but pursues them in the water. The mink does not find an easy prey, as the muskrats fight savagely; but, emboldened by hunger, he finally kills his victim, when he does not scruple to devour the whole body. Otters probably kill them, also, as they are occasionally found in muskrat houses.

Upon land, the muskrats are easily captured by various mammals and rapacious birds. They are readily trapped, as they are not at all suspicious, which operation, in former times, furnished many a youth with pocket-money, while older hunters made it their chief occupation. A steel-trap, baited with pieces of parsnip, or of sweet apple is generally used; or sometimes a trap without bait is placed in their runways. In winter, they are caught by driving a long-pronged spear through the tops of their houses into their nest, where they are lying together, several being frequently transfixed at a blow from a spear provided with several prongs. The Indians killed them thus, even with their primitive stone-headed spears. Sometimes they are shot, when sitting on the ice on sunny days in winter, or while swimming about, or basking on logs, in spring. In our Western rivers and lakelets, they are occasionally shot by hunters, who paddle silently about in canoes on moonlight nights.

Muskrat skins have been a considerable item in the commerce of America. Formerly, when the fur was largely used for napping "beaver hats," so called, they were of greater value than at present, being then worth more than the skin of the mink, selling, indeed, for from 40 to 50 cents each. Changes in the fashions of late years, including the general introduction of silk hats, have resulted happily for the persecuted muskrats, and for the last ten or twenty years their skins have been sold for from 8 to 15 cents each, and even as low as 6¼ cents; and trapping them has in a measure ceased. Within the last year or two, however, they have sold for somewhat better prices, being now largely used for making caps, gloves, and some articles of ladies' furs.

In Northern Illinois, the muskrat has not been so long persecuted by man, and therefore has not learned to fear his presence so much as in longer-settled regions. It is accordingly oftener seen out by day here than in the older States, where, in some localities, it is said to be almost strictly nocturnal, and exceedingly shy withal. Here they may not only be found feeding by day, but even at work, building their houses; and, while hunting ducks along the Des Plaines River, I have frequently shot them in broad day, as they sat upon logs at the water's edge.

In place of the living brooks and creeks, which drain wooded and uneven lands, we have here, on our level prairies, numerous broad and shallow depressions, that carry off the surplus water in rainy times, becoming dry in summer, except in places where they are

deeper and form large basins in which the body of water is so great as to hold out, despite the evaporation in ordinary seasons, while some are constantly supplied by springs, and never become dry. In these prairie water-courses and ponds, or sloughs,* as they are called, the muskrats were very abundant twenty years ago; but, though still occasionally seen in the larger ones, and numerous in some, their numbers are very small compared with their former abundance. In the sloughs, their houses were built like those in wooded rivers or marshes. They usually had burrows in the dry land at the edge of the sloughs, and when there was no spot nearer, sufficiently elevated to be above high water, a burrow would be dug at some distance—sometimes 15 or 20 rods—from the edge of the slough, and approached by a gallery excavated the entire distance under the sod. Some, in very wide marshes, appeared to have no burrows, living always in their large nests. Though the young are generally brought forth in burrows, they were often found in the houses in the sloughs, only one female, however, remaining in a house. The sloughs inhabited by them being of no great depth, and often dried up in summer, or frozen to the bottom in winter, the muskrats were frequently found wandering about in search of water; and even lately I have, in dry summers, occasionally found them on the prairie at great distances from water. Since the prairies have been settled and cultivated, the muskrats are generally observed living permanently only in large marshes, lakelets, and streams; they seem quite as much at home, however, in these, when situated on the prairie, as when in the timber; and old trappers assure me that they have never seen "rat" more abundant than they have been on the prairies of Northern Illinois.

The Pottawattamie Indians call the muskrat *shush-ko*; they eat the flesh, when boiled with corn or roasted, or cooked in various ways. The hunters and trappers consider the hind-quarters very palatable, when roasted on coals; and they, as well as the Indians, esteem the tail a great delicacy.

TRUE RATS AND MICE.

The species of the old genus Mus are numerous, and all very prolific. Three have been introduced, throughout the civilized world,

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* This is pronounced *sloos*, in our Western vernacular, and *slows*, by Walker and Webster. They are called "sloughs," as well when slight depressions, containing water only after rain, or when large marshes. Thus a slough, on high prairie, may have a solid, grassy bottom, or it may be miry and filled with bulrushes and other strictly aquatic plants, the name not being restricted to muddy and miry places, as the word "slough" would indicate in its original sense. The Pottawattamie Indians called a slough *wab-sko-kee*, a wet prairie; a very large one they called *che-wab-sko-kee*, big wet prairie; and an extensive, marshy water-course, which forms the chief source of the north branch of the Chicago River, is here very generally known as the "Sko-kee." The prairie sloughs are the favorite homes of many animals and plants, some of which seem peculiar to them.

by commerce. Departing entirely from what must have been their original mode of life, these have taken up their residence permanently in the dwellings of man, rendering themselves highly obnoxious by their mischievous habits.

COMMON HOUSE-MOUSE.

Mus musculus, LINNÆUS.

This is not a native species, but has been introduced from Europe. Whence it first came is not known. It always follows civilized man. Its habits and depredations in the house are too well known to need comment. In Illinois, I have found it breeding and living throughout the year in the fields, in considerable numbers. It digs burrows, sometimes in the open ground, at others under corn-shocks, or other shelter, and there collects its store of food, thus assuming the habits of the field-mouse, when adopting its home in the fields.

BROWN-RAT.

Mus decumanus, PALLAS.

This exceedingly troublesome animal is said to have been a native of Persia. It is only within the present century that it has been introduced into this country or Europe. It has spread with such rapidity that it is now abundant throughout all the long-settled portions of the Union, though it is only within a few years that it has been known in our recently-settled and interior prairie regions; and in some parts of which, indeed, it has not yet made its appearance at all. It often lives in the fields, like the preceding, and excavates large burrows under corn-shocks, &c., into one of which a pair will sometimes carry a full half bushel of shelled corn. In its burrow, it makes a large nest of the soft corn-husks and silks, or of grass.

Farmers are occasionally surprised by the sudden and entire disappearance of the brown-rats from their houses, where they were abundant a short time before; but, upon making inquiry in such cases, they may also find that some of their neighbors are quite as much surprised, and considerably more annoyed, at the equally sudden appearance of large numbers on their premises; and these migrations are by no means unfrequent.

For figure of the wood-rat (*Neotoma floridana*) of the Southern States, see Plate XIV.

BLACK-RAT.

Mus rattus, LINNÆUS.

This species, which seems to have been introduced originally from Asia, has been known in Europe and America much longer than the brown-rat, before which it always disappears. The black-rat was once abundant in parts of the United States, but is now unknown in many localities where it formerly bred. I believe it has rarely been found in a few localities in this region, the brown-rat having apparently found its way here before it.

Like the two preceding species, this is omnivorous, feeding upon almost any kind of vegetable or flesh. Both rats devour eggs, and even capture living animals, with all the ferocity of strictly carnivorous species.

BIRDS

INJURIOUS TO AGRICULTURE.

BY EZEKIEL HOLMES, M. D., OF WINTHROP, MAINE.

Nothing has been created in vain; and yet the seeming paradox is true, that it is man's duty to subdue the earth, and to destroy, as inimical to his welfare, many things existing in Nature, both animate and inanimate. The birds of the air are beautiful and perfect, and the world would be incomplete without them. They are all doubtless designed for the performance of useful functions in the economy of the general plan of which they comprise an integral part; but so many evils to the pursuits of man in his primitive condition proceed from the practices of many of these, that their destruction appears to be imperatively demanded, and is executed alike without motives of cruelty or the fear of transgression, just as others are destroyed to provide the human family with food.

To discriminate between the varieties, with respect to their useful, inoffensive and pernicious characteristics; to know their varied habits; the times and seasons of their coming and going; the means of capturing them; and other facts connected with them, is important to every cultivator of the soil; and it is with the view of imparting this knowledge that the following pages have been prepared. For the purpose of rendering them full, accurate and reliable, reference has been had to the works of a number of

approved authors, among which may be named those of Audubon, Nuttall, Wilson, and others, as useful guides in the performance of the task.

With respect to the influence of some of the birds comprehended in the list herein described, there will doubtless exist contrariety of opinion, since just conclusions can only be derived from an intelligent and impartial examination and estimate of the good and evil, whether direct or indirect, proceeding from the habits of each species. Although it has been the design of the writer to treat only of "Birds Injurious to Agriculture," yet he does not assume to determine these points unqualifiedly. The birds described are usually regarded as injurious. The evidence upon which they are so regarded is here presented, and upon it, together with the practical experience of the intelligent and interested farmers and planters of the country, a safe and equitable verdict must depend.

RED-TAILED BUZZARD.

[PLATE XV.]

Falco borealis and *Falco leverianus*, WILSON.
Falco borealis, AUDUBON and NUTTALL.
Buteo borealis, SWAINSON and RICHARDSON.

DESCRIPTION.—Length from 20 to 22 inches; stretch of wings, 3 feet, 9 inches, or more, yet wings considerably shorter than tail; bill, greyish-black; cere, sides of mouth, and legs, yellow; upper parts dark-brown, touched with ferruginous; wings, dusky, barred with blackish; scapulars, barred beneath surface; tail, rounded, bright-brown or brick-color, band of black near end, tipped with brownish-white; beneath, brownish-white; breast, rusty, streaked with dark-brown; band, interrupted spots of brown across belly; chin, white; vent and femorals pale-ochreous, the latter with heart-shaped spots of brown; iris, yellow. Tail of female, ferruginous, blackish subterminal band. Young, tail, pale dusky-brown, crossed by nine or ten narrow blackish bands.

The red-tailed buzzard, "Hen Hawk," or *grand mangeur de poules*, is a resident of every part of the Union, and of Canada, but performs partial migrations to the Southern States in very severe winters, where, indeed, it is at all times most abundant. In Louisiana, it builds its nest early in February, on the largest and tallest tree it can select in the forest, yet not remote from the farm-houses; but in Massachusetts, not until May. The male and female toil hard for eight or ten days in carrying up dried sticks, slender twigs, and coarse grass, or Spanish moss. The nest is large, of flattened form, and located in the centre of a triply-forked branch, and contains four or five very hard and smooth eggs, of dull-white color, spattered with brown or black. Sometimes, though rarely, a nest is found upon an isolated tree. The flight of this bird is firm, long-

continued, and at times very high; and it sails a great distance without any apparent motion of its wings, but often repeatedly utters, in a prolonged, mournful cry, without inflection or variation of intensity, the sound *kae*, with no other purpose seemingly than to admonish the usual objects of his prey of the danger in which they stand. Upon espying any of these, it usually descends to a convenient perch, from which, with closed wings, it makes a dart with almost unerring accuracy and success. Sometimes, it flies over a field very near the ground, and, upon perceiving its prey, ascends in a beautiful curved line to the top of the nearest tree, from which it again descends in the manner described. At other times, it will alight in the field, devote a few minutes to pluming itself, and then ascend in a series of circles so high as to look like a mere dot in the heavens; yet from this height, it no doubt perceives very minute objects; for it occasionally suddenly descends to seize its unsuspecting victim. From a well-chosen position upon a tall tree, it also at times quietly and patiently watches. Squirrels, rabbits, tame pigeons, chickens, wood-rats and meadow-mice are its common food. Soft-shelled tortoises are often aimed at by it, but can escape by diving. It is bold in its assaults upon the fowls of the farm-yard, and is much dreaded by the farmers in many localities.

Though these buzzards hunt in pairs for their young, during the breeding season, and are very careful of them, when this period is over, they become strangely alienated, and often fight with great fury for the possession of a morsel of food which one of them has captured. Their flesh is not fit to eat. Like other birds of its kind, it is covered with parasitic vermin, which are large and of auburn color.

HARLAN'S BUZZARD.

[PLATE XVI.]

Falco harlani, AUDUBON.

DESCRIPTION.—Length, 21 inches; extent of wings, 45 inches; bill along the back, 1½ inches; tarsus, 1¾ inches; plumage, compact; general color, deep chocolate-brown; under parts, lighter; feathers, margined with light-brown; tail, lighter than the back, narrowly barred with brownish-black, tips brownish-red; under wing-coverts whitish, spotted with deep-brown; head and neck short and rounded; tibial feathers, elongated and loose at tips; wings, long, first quill, short, fourth, longest, third and fifth, equal; tail, longish, ample, 12 inches broad, rounded feathers; bill, light-blue, black towards end; cere and angles of mouth, yellowish-green; iris, light yellowish-brown; feet, dull greenish-yellow; claws, black.

Harlan's buzzard was added to the fauna of the United States by Mr. Audubon about the year 1830, and by him called after Dr.

Richard Harlan, of Philadelphia. He speaks of two specimens only, which were captured in Louisiana. They had bred in the neighborhood of the place where found for two seasons, but their nest was not seen. Their young are said to appear of a leaden-grey color at a distance, but to become as dark as the adult birds at the approach of winter. These birds were successively seen perched on the top of a high tree, standing in an erect attitude, and appeared so like the black-hawk (*Falco niger*) of Wilson, as to be at first taken for it. They were hard to approach, and when severely wounded and captured they proved fierce, courageous and intractable, and died refusing food. They were considerably smaller than the red-tailed hawk, to which they are allied, but superior in daring; their flight is rapid, protracted, and so powerful as to enable them to seize their prey with apparent ease, or to effect their escape from the red-tailed hawk, which pursues them on all occasions. They have not been observed to fall on hares or squirrels, but at all times evince great fondness for common poultry, partridges, and the smaller species of wild ducks.

BROAD-WINGED BUZZARD.

[PLATE XVII.]

Falco pennsylvanicus, Wilson, Bonaparte, Audubon, and Nuttall.

Description.—Length, 14 inches; expanse of wings, 33 inches; bill, black, bluish near base, and slightly toothed; cere and corners of mouth, yellow; from the mouth backward, a patch of blackish-brown; upper parts, dark-brown, beneath the surface, spotted and barred with white; head, large, broad and flat, streaked with whitish; tail, short, black, two bars of white, tipped with whitish, and exterior and interior feathers still shorter; tail-coverts, spotted-white; wings, dusky-brown, obscurely barred with black; most of inner bands, partly white; lining of wing, brownish-white, with small arrow-heads of brown; chin, white, surrounded with streaks of black; belly and vent, like breast, white, but more thinly marked with pointed spots of brown, femorals, pale brownish-white, thickly marked with small touches of brown and white; legs, stout, and dirty orange-yellow; feet, coarsely scaled, of same color. Female, much larger, light-colored over the eye, being rufous-white with minute spots; femorals and beneath the wing, marked with cordate spots; beneath, rufous-white, with oblong dusky-brown spots. Belly and rump, same color, but spotless.

It is believed the broad-winged hawk is never seen in Louisiana except during the severest winters of the Middle and Eastern districts of the United States. Its usual range seldom extends far west of the Alleghany Mountains; but in Virginia, Maryland, and the States eastward, it is by no means a rare species. Its nest is about the size of that of the common crow, and is usually placed on large

branches, and near the stem or trunk of the tree, being composed, externally, of dry sticks and briers, and internally, of numerous small roots, and is lined with the large feathers of the common fowl and other birds. The eggs are four or five in number, and of a dull greyish-white, blotched with dark-brown. They are deposited as early as the beginning of March in low situations in the South, and a fortnight later in mountainous parts; but not until April in the northern extent of its range. It is believed that but one brood is ever raised in a season.

The flight of this hawk is easy and performed in circles. When high in the air, it often closes its wings for a moment, and glides gracefully along. It seldom pursues other birds of prey, but is itself frequently teased by the little sparrow-hawk, the king-bird, or the martin. It attacks birds of weak nature, particularly very young chickens and ducklings, and during winter, feeds on insects and various small animals. Except during the winter season, it flies singly. After eating, it rests for hours upon the top of a small tree within the forest. Like other birds of its tribe, when wounded, it throws itself on its back, opens its bill, protrudes its tongue, utters a hissing sound, erects the top feathers of its head, and with its talons grasps any object presented to it, insomuch that it may be carried by means of a stick thus clutched as long as its muscular power continues. When feeding, it holds its prey with both feet, and tears and swallows the parts without much plucking. In its stomach have been found wood-frogs, portions of small snakes, and the hair of small quadrupeds of several species.

WHITE-HEADED OR BALD EAGLE.

[PLATE XVIII.]

Falco haliæetus and *F. ossifragus*, WILSON.
Aquila leucocephala, SWAINSON and RICHARDSON.
Falco leucocephalus, BONAPARTE, AUDUBON, and NUTTALL.

DESCRIPTION.—Length, 34 to 36 inches; stretch of wings, 7 feet; plumage of body and wings, deep yet lively-brown or chocolate-color; head and upper part of neck, tail and coverts, pure white, in the female, inclining slightly to straw-color; bill, cere, and feet, yellow; iris, whithish-yellow. In the first year, white of head and neck blended with greyish-brown and variegated with two colors in the second year. In the first season, the young resembles that of the white-tailed eagle, except that its plumage is less regularly varied with brown colors, and that the tail is somewhat longer.

The white-headed or bald eagle may at all times be seen in every latitude of the United States, but prefers the low-lands of the seashore, as well as those of large lakes, and the borders of rivers. The roosts and feeding-places of pigeons are resorted to by it, for the purpose of picking up the young or wounded which happen to be

exposed. But it seldom follows the flocks of these birds in their migrations. Its figure is well known as that with which our national escutcheon is emblazoned. In power of flight, it is unequalled, and its strength and cool daring are objects of universal admiration; but it is also ferocious, overbearing and tyrannical. Its flight is firm and uniform, and protracted to any distance, at pleasure. In travelling, it is supported and propelled by the equal, easy and unintermitted flapping of its wings. When looking for prey, it sails with wings extended at right angles to its body, its legs at times hanging at their full length. While sailing, it has the power of ascending in circular sweeps, without any perceptible movement of its wings, or any apparent motion of its tail; and thus it often rises out of sight, occasionally closing its wings to descend, when it again ascends as before. From its greatest elevation, it often perceives minute objects upon the earth, and its descent at such times is so rapid as to produce a loud rustling noise, not unlike that occasioned by a violent gust of wind among the branches of trees, and to be almost imperceptible to the eye. When a goose, duck, or swan, upon the water, is the object of its desires, the aid of its mate is called into requisition, and they approach the quarry obliquely from different directions, the first one descending, and causing the intended victim to dive, and then the other, upon its reappearance, compelling it to dive again; and so on until the affrighted bird is seized, which is usually as soon as it reaches the shallow water near the shore; and, when it is captured, they divide their spoil. Pigs, lambs, fawns, and poultry are often carried off and devoured by these eagles; and vultures, carrion-crows, and dogs are driven by them from feasting upon the flesh of putrid animals; and the vultures and crows are even followed and compelled to disgorge the food they have swallowed, which the eagle descends and devours. In very shallow water, it sometimes catches fish by striking them with its talons; but it systematically follows the fish-hawk, or osprey, while on the wing, and compels it to drop its prey, to which it quickly descends, seizes, and carries to the woods to devour, or conveys to the eyrie for its young. It is panic-stricken when surprised by man, and retreats in confusion, uttering a hissing noise unlike its usual disagreeable imitation of a laugh. It is hard to approach with a gun; but, like many other birds, it appears to know the power of this weapon. It is often surprised by persons who steal upon it under the cover of a tree, on horseback, or in a boat; and it may also be caught in a well-constructed trap, baited with a chicken or other objects of its prey. During the continuance of snow upon the earth, its sight is sometimes so affected that it can but imperfectly discern one's approach. When brought to the ground by a gunshot, it tries to escape by repeated leaps, and soon conceals itself, if not closely pursued. When it falls into the water, it strikes powerfully, with expanded wings, and thus often gains the shore, if not more than 20 or 30 yards distant. It defends itself after the manner of other hawks, by throwing itself backward, striking with its talons, and keeping its bill open. Its eyes are then remarkably protruded,

and its head is quickly turned from side to side to watch the movements of its enemy. It doubtless lives to a great age, but evidence is wanting of its continuance for 100 years, or for any other very protracted period.

This eagle is seldom seen alone, the mutual attachment of a pair continuing through life. They seldom feed apart, but will not often tolerate the presence even of other birds of their own species. Their periodic amatory season commences earlier, perhaps, than that of any other land-bird, generally, in December, at which time, along the Mississippi, or by the margin of some lake not remote from the forest, they make much ado, flying about in circles, uttering loud, cackling noises, alighting on dead branches of trees, caressing each other, and constructing their nests. Incubation commences in the beginning of January. The nest, which is in some instances very large, is usually placed on a very tall, healthy tree, though destitute of branches to a considerable height. This nest is composed of sticks from 3 to 5 feet long, pieces of turf, rank weeds, and Spanish moss, in abundance, whenever this latter substance happens to be near. When finished, the nest measures from 5 to 6 feet in length, and eventually the same in depth, as something is added to it, or some improvement made, every year it is occupied. The eggs, which are usually two or three in number, and sometimes four, are of a dull-white color, equally rounded at both ends, and sometimes granulated. The incubation lasts for more than three weeks, but the precise number of days has not yet been determined.

The first plumage of the young is of a greyish color, mixed with brown of different depths of tint, but before leaving the nest, they are fully fledged. The attachment of the parents for them, while they need protection, is very great; but, when they are able to take wing and provide for themselves, if they do not fly off, the old ones beat them away. They return, however, to roost or to sleep near the nest for several weeks. They pair the following winter and breed the ensuing spring; but the mates are not always of equal age, a male at least five years old having been found paired with a female in her first year. They do not attain their full beauty of plumage until they are three or four years old, and the whiteness of the head, in some instances, has been observed to be wanting until the fifth or sixth spring. Their local attachments are so strong that they seldom spend a night away from the vicinity of the nest they first establish. A hissing snore, which may be heard a hundred yards off, accompanies their sleep, and yet the crushing of a twig upon the ground excites their vigilance. Though driven from their roosts by attemps to shoot or smoke them, they still return on the following night. Hundreds might be seen in a journey from the mouth of the Ohio to New Orleans before the era of steam navigation; but now, both they and the game upon which they feed are less abundant.

LARGE-FOOTED HAWK.

[PLATE XIX.]

Falco peregrinus. BONAPARTE, NUTTALL, and AUDUBON.

DESCRIPTION.—Heavy, compact, firmly built, and muscular; length, 16½ inches; extent of wings, 30 inches; bill, 1⅛ inches along ridge; tarsus, 1⅞ inches; middle toe, 2½ inches; bill, greyish or blackish-blue at tip, pale-green at base; cere, oil-green; bare orbital space, orange; iris, hazel; feet, lemon-yellow; claws, brownish-black; head and hind-neck, greyish-black, tinged with blue; rest of upper parts, dark bluish-grey, indistinctly barred with deep-brown; quills, blackish-brown; inner webs marked with transverse elliptical spots of reddish-white; tail, greyish-brown, marked with about twelve bars, the last of which is broad, the rest diminishing in intensity of shade; throat and fore-neck, white; broad band of bluish-black from angle of mouth downwards; cheeks, whitish-grey; sides, breast, and thighs, reddish-white, transversely marked with dark-brown spots in longitudinal series; under-wing feathers, whitish, transversely barred; but the plumage changes with age, the upper parts becoming lighter in the male, the back sometimes ash-grey; in the female the hue deepens.

The large-footed hawk was almost unknown in the United States at the begining of the present century; but of late years it is often seen. In Louisiana, where it is most abundant in the winter, and in the Southern States, generally, it lives along water-courses and the shores of the sea or lakes.

This hawk is believed to be identical with the common wandering, or passenger falcon of Europe, well known in regal sports in former times, and still highly valued in Persia, Tartary, and China, where falconry is still practised. It doubtless lives to a great age; but upon this subject, very improbable facts have been recorded. Its flight is of astonishing rapidity, and its quick evolutions, when pursuing its prey, are not less so. When it has seized it, if the victim is too heavy to be carried off, it descends obliquely to the ground to devour it; otherwise, it carries it to a sequestered place. The smaller ducks, water-hens, and other swimming birds are often seized by it upon the surface of the water; and at the report of a gun it has been known to seize and carry off a wounded teal within 30 yards of the sportsman who shot it. A mallard is perhaps the largest duck it will attack. Wild or tame pigeons, black-birds, and snipes are also among its prey.

This bird often perches on the dead branch of a tall tree, especially near the resorts of the common snipe, where it watches for prey, and seems, by the movement of its head, to be counting the objects it discerns. On seeing an eligible victim, it descends like an arrow, seizes the unsuspecting bird, and flies to the nearest wood to feast upon it. It is more cleanly than the greater portion of its

species, in its choice of food and manner of feeding, yet, at times, it devours dead fish found floating at the margin of the water.

Except in its breeding season, which is believed to commence in mid-winter, as the young go forth in early summer, this hawk is solitary in its habits, often making its roost in the hollow of a tree, the crevice of a high cliff, or other isolated place.

SHARP-SHINNED HAWK.

[PLATE XX.]

Falco pennsylvanicus and *Falco velox*, WILSON.
Falco fuscus, AUDUBON.

DESCRIPTION.—Male, 12 inches long, 21 inches alar extent; female, 14 and 25 inches; bill, bluish-black; cere, greenish-yellow; eye-brows, strongly projecting; iris, reddish-orange; upper parts, deep slate-blue; feathers, shafted and black; primaries, brownish-black, barred with dusky; lining of wing, crowded with heart-shaped black spots; tail, 3 inches longer than wings, nearly even, ash-colored, crossed with four broad bands of black, and tipped with white; over the eye, a narrow stripe of dull-white; chin, white, mixed with black hairs; breast, belly, and femorals, variegated with broad transverse, brownish spots; vent, pure white; legs, long, slender and bright-yellow; claws, black, remarkably sharp and large. Young, dark-brown, skirted with ferruginous; beneath, white with narrow, oblong, ferruginous spots.

The sharp-shinned hawk ranges far to the North and to the South, and is met with in every State and Territory, but is more abundant in the Middle and Southwestern States than in the Northern; and, although it has no regular migration, it frequently retires a short time from their northern limits in very severe winters, perhaps more for the sake of a better supply of small birds than from any other cause. Mr. Audubon pronounces it "the miniature of the goshawk." Not only is this likeness in its appearance, but in the irregular, swift, vigorous, varied, yet often undecided manner of flight, which is at times, however, greatly protracted. It moves by sudden dashes, as if impetuosity of movement were essential to its nature, and pounces upon, or strikes such objects as best suit its appetite, but so very suddenly that it appears quite hopeless for any of them to try to escape. It is often seen to descend headlong into a clump of briers, regardless of all thorny obstacles, and to emerge from the other side clutching in its sharp claws a sparrow or a finch. At other times, two or three of them may be seen conjointly attacking a golden-winged wood-pecker, which had taken position against the bark of a tree in fancied security. While defending itself from the attack of one or two of these hawks, the wood-pecker is usually vanquished by the efforts of another, which thrusts its legs forward with vivid quickness, protrudes its sharp talons and seizes the vic-

tim by the back, which it tears and lacerates. Thus wounded, it falls to the ground with its captor, where the struggle is continued; but a disengaged hawk now tears out its vitals with its claws, and the repast of the assailants commences. Young chickens are often seized by it, even in the presence of their keepers; and as many as twenty or thirty have been carried away by one hawk in as many consecutive days. Birds of various sizes, from the smallest warbler to the passenger pigeon, and small reptiles and insects, also, it is said, comprise its food.

The roosting-places of these hawks, in ordinary seasons, are in the fissures of rocks, in tall trees in isolated situations, and in precipitous declivities overhanging turbulent streams; but it cautiously retires after daylight has departed, and leaves its resting-place before the light of morning. Its nest has not often been invaded by the curious investigator into its habits at the season of incubation. Mr. Audubon says: "I found a nest of this hawk in a hole of the well-known 'Rock-in-cave,' on the Ohio River, in the early part of the spring of 1819. It was simply constructed, having been formed of a few sticks and some grass carelessly interwoven, and placed about two feet from the entrance of the hole. The eggs, four in number, were nearly hatched. They were almost equally rounded at both ends, though somewhat elongated. Their ground color was white, with a livid tinge, scarcely discernible, however, amidst the numerous markings and blotches of reddish-chocolate with which they were irregularly covered." He afterwards found a nest in the hollow prong of a sycamore, on the Ohio, near Louisville, and another in the forks of a low oak upon the prairie land near Henderson, Kentucky.

SNOWY OWL.

[PLATE XXI.]

Strix nyctea, LINNÆUS.

DESCRIPTION.—Length of female, 26 inches; alar extent, 54 inches; iris, bright-yellow; claws, black; body, white, more or less spotted and barred with dusky-brown; tail, rounded, reaching a little beyond the wings; feet, thickly clothed with long feathers; bill, black; female, more spotted than male, which alone becomes wholly white by age. Young, issuing from nest, downy covering, brown and first feathers pale-brown.

The snowy owl is merely a visitor of the United States from more northern regions. It is seldom seen earlier than November, and retires as early as the beginning of February. It wanders at times along the coast as far as Georgia, and is sometimes seen in Ohio and the lower parts of Kentucky; but is more frequently met with in Pennsylvania and New Jersey, and in Massachusetts and Maine

is abundant. There is but little information respecting its place and mode of breeding, which, however, is in higher latitudes than the United States.

This owl hunts in the day as well as at night. Its flight, though noiseless, is swift, firm and protracted. Ducks, grouse, and pigeons are pursued by it upon the wing, and stricken down. It catches fish and clams in shallow waters; watches the traps set for musk-rats, and devours such as are caught in them, and feeds also upon hares, squirrels, and rats. It may be caught—though less frequently than the grey-owl, which it exceeds in sagacity—in traps baited with muskrats. In its native regions, it comes with surprise upon its prey, being undistinguishable from the surrounding snow. It is exceedingly voracious, and has been known to swallow a rabbit whole. It is very strong also. I was once successful in obtaining a living specimen, which I placed in a room in my house for security, but found in the morning that my captive had broken the window panes and fled.

BARRED OWL.

[PLATE XXII.]

Strix nebulosa, Wilson, Bonaparte, Audubon, and Nuttall.

Description.—Length of female, 22 inches; the male, smaller, greyish-brown with transverse whitish spots; beneath, whitish; neck and breast, with transverse bars; belly and vent, with longitudinal stripes of brown; iris, brown; bill, yellow; tail, very convex above, extending considerably beyond tips of wings, and barred with five or six stripes of brown; fore-part of neck and breast, whitish, barred transversely with pale-brown; below, striped longitudinally with brown to the tail; legs, clothed with short feathers; extremity of toes, covered with scales. Female, with scapulars of dark-brown, and wings more spotted with white. The young have the tints deeper and bill horn-colored.

The barred owl is found in the northern regions on both sides of the Atlantic, but on this continent extends its home at least as far southward as the limits of the United States; and it is perhaps more abundant in Louisiana than in any other State, especially when the winters of the North are severe—so abundant, indeed, that, in the forests, numbers of them may be seen within a ride of a few miles, even in broad daylight. At night-fall, their cries may be heard in every direction, whether in the woods or on the plantation; and at the approach of rain these cries throughout the day and night become exceedingly frequent and vociferous. When pursued, its actions are grotesque. It watches its pursuers from its perch, lowering its head and throwing forward the lateral feathers, so as to produce the appearance of a ruff. It will not retreat far

unless fired at. It may be decoyed by a passable imitation of its cry of *whah-whah-whah.*

The flight of the barred owl, at night, is smooth, light and noiseless, and at times protracted. In cloudy weather, it also flies by day, but noiselessly, in the dense wood-lands. The grey-squirrel, and other prey which it would seize at night, it fails to secure in the day, because of its imperfect vision. It is a great destroyer of poultry, particularly half-grown chickens, which it steals from their roosts, upon trees or elsewhere, even in the vicinity of dwellings. Mice, young hares, rabbits, and many species of small birds and frogs, also comprise its food.

About the middle of March, these owls begin to lay their eggs on the dust of decomposed wood in hollow trees, or in the old nest of a crow, or red-tailed hawk. The eggs are globular, pure white, have smooth shells, and are from four to six in number. It is believed that only one brood is reared in a season. The young are covered with a downy substance, some of which is intermixed with, and protruding from, the feathers for weeks after the bird is nearly fledged. They are fed by the parents for a long time, on which occasions they make a hissing noise that may be heard for 50 or 100 yards. When domesticated, they prove admirable mousers, but unfortunately cannot be restricted to the destruction of mice in the exercise of their natural propensity. All species of day-birds are their enemies, and pursue and annoy them with great pertinacity, but seldom have the power to injure them.

LARGE-HORNED OWL.

[PLATE XXIII.]

Strix virginiana, Wilson, Bonaparte, Audubon, and Nuttall.

Description.—A very large species. Male, 20 inches long; bill, black; iris, bright-yellow; horns, broad, 3 inches long, formed of twelve or fourteen feathers, with black webs, and edged with brownish-yellow; face, ferruginous, bounded by a band of black; whitish space between bill and eyes; beneath, marked with numerous transverse dusky bars on yellow and white ground; vent, paler; feet, covered with hair-like pale-brown feathers; claws, black; tail, rounded and broad, passing an inch or more beyond the wings, mottled with brown and tawny, and crossed with six or seven narrow bars of brown; above, whitish and ferruginous, thickly mottled with dusky; chin, whitish, beneath a band of brown, and then another narrow one of white. Female, 24 inches long, white on throat, less pure, and less ferruginous below.

The large-horned owl, or cat-owl, may be met with from Hudson's Bay to Florida. All climates are alike to it, and it inhabits both the mountain and the valley, but is partial to the vicinity of rivers and lakes, probably because of the abundance of prey in such

situations. It has been called the "Eagle of the night," and a "Nimrod of the feathered tribes," because of its prowess and courage. Next to the snowy owl, it is the largest of its genus, and is one of the most common along the shores of the Ohio and Mississippi, where it may be met with at all seasons, roosting in the young cotton-wood trees and willows of the banks; and also upon the cypresses of the swamps. When the sun glares, it may be easily approached, but in cloudy weather, it promptly retreats, and appears to know that a flight across the stream is conducive to its safety. Its flight at night is elevated, rapid and graceful. It sails with apparent ease, and circles wide, in the manner of an eagle, rising and descending without difficulty, merely by inclining its wings on its tail. At times, it glides silently near the earth, with incomparable velocity, and falls, as if shot dead, on its prey beneath. At other times, it alights on a fence, or dead stump, shakes and adjusts its feathers, and utters a horrid shriek, in which the woods echo; again, its sounds are like the barking of a cur-dog; then a gurgling noise like the stifled groans and cries of a man in distress; and at other times its *hoo-hoo-hoo-e*, (in B flat, it is said,) uttered near the listener, seems like the cry of an owl a mile off. This is sometimes so well imitated by the human voice, that numbers of these owls are lured to the encampments of boatmen and hunters. In the intervals between these cries, it snaps its bill with vehemence, and turns its head from side to side in a ludicrous manner. Failing to repair to the woods before the return of day, it is obliged to settle down on some apparently quiet spot; but the little birds prove very annoying to it here, and, when the king-bird approaches, it is compelled to retreat, though unconscious of its way.

The food of this owl consists chiefly of half-grown wild turkeys, pheasants, and domestic poultry of all kinds, together with several species of ducks. Hares, young opossums, squirrels, and mice are equally agreeable to it, and whenever chance throws a dead fish on the shore, it feeds on it with avidity.

Owls of this variety pair early in February, when the wooing and the nuptials are indicated by exceedingly grotesque manifestations of ceremonies and rejoicings. The nest, which is very bulky, is usually fixed on a large horizontal branch, not far from the trunk of the tree, or where two limbs branch off, but sometimes is made in a hollow tree, or in the fissure of a rock. It is composed externally of crooked sticks, and is lined with moss, coarse grass, and some feathers, the whole measuring nearly 3 feet in diameter. The eggs are from three to six, almost globular, and of a dull-white. The male assists in sitting. But one brood is reared in a season. The young remain in the nest until fully fledged, and afterwards follow the parents for a considerable time, uttering a mournful sound in supplication for food, by which they are often detected by the hunter. They acquire full plumage the first spring.

The large-horned owl, after the breeding season, lives a solitary life, and a single one of them appropriates to himself the range of a neighborhood or farm, and the havoc it commits is very great,

often to the extent of destroying all the poultry of a plantation during a winter. It is very powerful, and equally spirited, often attacking and mastering half-grown wild turkeys. Mallards, Guinea-fowls, and common fowls prove an easy prey to it, and it often enters hen-roosts in the Northern States, in quest of food. When wounded, it contends with its assailant with a revengeful spirit, protruding its talons, snapping its bill, and expanding its great goggle eyes.

KING-BIRD.

[PLATE XXIV.]

Muscicapa tyrannus, WILSON, AUDUBON, and NUTTALL.
Lanius tyrannus, LINNÆUS.

DESCRIPTION.—The king-bird is 8 inches long; alar extent, 4 inches; general color above, dark-ash, approaching black; head and tail, nearly black, the latter tipped with white, and extending far beyond the wings, which are of a faint-brownish umber cast; upper part of breast, tinged with ash, rest of lower parts pure white; plumage of crown at discretion forms a rough crest, below the black surface of which is seen a bed of scarlet, inclining to orange, surrounded and based often with white; bill, broad at base and black; legs and feet, black; iris, hazel.

The king-bird, or "Field Martin," as it is sometimes called in the Southern States, remains at the North during the spring and summer; and, although men destroy it, Mr. Audubon declares its occasional destruction of a honey-bee, and larceny of a few raspberries and figs, to be the only mischievous acts it commits, while, he alleges, its beneficial deeds are countless, insects chiefly caught upon the wing being its accustomed food. It appears in Louisiana about the middle of March, and continues until the middle of September. Further northward, over the entire country, it comes later and disappears earlier. For a few days after its arrival, it seems fatigued and doleful, and remains perfectly silent; but its sharp, tremulous cry is soon heard over the fields and along the skirts of the woods. It seldom enters the forests, but is fond of orchards, large fields of clover, the neighborhood of rivers, and the gardens close to the houses of planters. On the return of their love-season, which is very soon after their coming, their manner changes. They are then seen flying about in pairs, with a quivering motion of their wings, at a height of 20 or 30 yards, the females in advance, uttering loud and tremulous shrieks, and occasionally darting aside from their playful rounds to seize and devour a hapless insect, or lighting close together upon the twig of a tree, where their mutual caresses are enjoyed. Soon, they begin to gather dry twigs from the ground, and arrange them in order on a horizontal

branch, as the foundation of their nest. Flocks of cotton, wool, or tow, and other like substances, are placed in thick and regular layers, giving great bulk and consistence to the fabric, which is finally lined with horse-hair and fibrous roots. The eggs are from four to six, broadly-ovate, reddish-white, or bluish color, irregularly spotted with brown. As soon as incubation has commenced, the male, full of ardor, evinces the most daring courage, and gallantly drives off every intruder. Perched on a twig in view of his mate, he seems to direct every thought and action to cherish and protect her; and, though he seldom meddles with small birds, yet often flies to their rescue, when he espies a crow, a vulture, an eagle, or a martin making any approach, spreading his wings to the air, and pressing toward the dangerous foe, he commences his attack with fury. Mounting above the enemy, he sounds the charge, somewhat like a watchman's rattle, repeatedly plunging upon the back of his powerful antagonist, and essaying to secure a hold. In this manner, he harasses him with continued blows, and follows him at times for a mile, when, the fugitive having sought refuge in the forest, with quivering wings and trilling notes, the little bird returns exultant to his nest. Audubon says, that the martin alone, of all aerial enemies, inspires him with fear; that, although this bird frequently aids him in protecting his nest and watching over the farm-yard, it sometimes attacks him, and, excelling him in quickness and power of flight, eludes his more powerful blows, and in some rare instances, destroys him. Few hawks venture to approach a farm-yard while the king-bird is near; and even the cat, tormented by his attempts to peck on all sides, retreats from before him to the house.

About the month of August, this bird becomes comparatively mute, and resorts to old fields and meadows, where he sullenly sits and watches his prey, which he seizes, beats and swallows with more directness and avidity than before. Pursuing insects over rivers and lakes, he sometimes descends and drinks like swallows, or, if the weather be warm, he plunges repeatedly into the water, and then retires to a tree to dry and arrange his feathers. Soon, perceiving birds of his tribe passing over his head, he ascends to join them, and they hie away to a Southern clime. Thus, at the begining of September, parties of twenty or thirty may be seen in the Middle States, passing off with strong and decided movements of the wings at regular intervals, and by the 1st of October none are to be found.

BLUE-GROSBEAK.

[PLATE XXV.]

Loxia cœrulea, WILSON.
Fringilla cœrulea, BONAPARTE, AUDUBON, and NUTTALL.

DESCRIPTION.—Length, 6 inches; extent, 10 inches; purplish-blue; more dull and spotted on the back; coverts of the wings, edged with bay; quills,

skirted with blue; tail, forked, edged with bluish, sometimes slightly tipped with white; legs and feet, lead-color; bill, dusky-blue, inclining to horn-color; eyes, large, full and black. Female and young, dark-drab, tinged with blue; the males supposed to undergo a double moult.

The blue-grosbeak is a somewhat rare bird. It arrives in the lower parts of Louisiana about the middle of March, the males appearing eight or ten days before the females, in small parties of five or six, when their common call-note, a single chuck, is frequently uttered to attract the females. They proceed through Alabama, Georgia, and the Carolinas, in all which States they breed. Beyond this, few are seen. They seldom ascend above Natchez on the Mississippi, or along the coast beyond New Jersey.

A field little frequented by other birds is usually taken possession of by one or two pairs of these birds. They build their nests in secluded positions, in the upright forks of some small slender shrubs, or even upon the tall blades of rank grass, notwithstanding their fondness for ascending to the tops of the tallest detached trees, to sing during the spring and summer. Their nests are composed of fine, dried grass, and lined with a few delicate fibrous roots, horse-hair, or dried moss. There are seldom more than four eggs. Two broods, however, are raised in a season. When the first leave their parents, the young birds assemble in small flocks, composed of a few families, and resort mostly to the rice-fields, in the regions of its cultivation, feeding on the grain when in its milky stage, until it is gathered. The parents soon join them with their second brood, and shortly after, or early in September, they all depart southward.

While the female sits upon her nest, the male often ascends to the top of some high tree near by to breathe forth his pleasant melody. He provides her with food, at times relieves her from duty, and on her return delights her again with his song; but, after the breeding season has passed, he seldom sings.

These birds are so shy as to be difficult to catch, especially the male; nor do they often sing when caged. Seeds of different kinds, rice, grass, and Guinea-corn are their usual food. It is believed that they do not eat berries nor other fruit.

ROSE-BREASTED GROSBEAK.

[PLATE XXVI.]

Loxia rosea, WILSON.
Fringilla ludoviciana, BONAPARTE, AUDUBON, and NUTTALL.

DESCRIPTION.—Length, 8½ inches; alar extent, 13 inches; above, black, except second row of wing-coverts, which are broadly tipped with white; a spot of same on primaries; chin, neck, and upper parts of breast, black; lower part of breast, middle of belly and lining of wings, light-carmine tint; tail, forked,

black, and exterior feathers on each side, white on inner vanes for an inch or more from tips; bill, white, rather dusky in females, which is also much larger than the male; legs and feet, greyish-blue; iris, hazel.

The usual natal region of the rose-breasted grosbeak is as far north as New Brunswick, Nova Scotia, and Newfoundland, but it winters south of the United States. Early in March, it appears in the lower parts of Louisiana, making its way eastward. It does not linger in the maritime regions of the Southern States, but is at times found in limited numbers in the mountainous districts of Georgia and the Carolinas. Early in May, it has proved plentiful along the precipitous banks of the Schuylkill, 20 or 30 miles from Philadelphia, and later in the season, on the Mohawk, in New York, being equally abundant along the shores of Ontario and Erie Lakes; it has also been seen westward as far as Cincinnati. The nest of this species is generally placed on the top branches of an alder bush, near water, and on the border of a meadow or alluvial ground, being composed of the dry twigs of trees, mixed with a few leaves and the bark of vines. It is lined with fibrous roots and horse-hair; yet the most elevated part of the highest tree is sometimes selected. The eggs, which have been found on the 20th of May, in New York, are seldom more than four in number, and but one brood is reared in the season. Both sexes incubate.

This grosbeak, in travelling south about the 1st of September, passes high over the forests, in the manner of the king-bird and robin, alighting towards sunset on a tall tree, from which it in a few minutes dives into a thicket to pass the night. It travels singly at this season, as well as in the spring.

The food of this bird consists of insects, and of the Cereals and grasses. Three years are required for the perfection of its plumage. The song of the male is exceeded by that of no other American bird except the mocking-bird, "so rich, so mellow, so loud in the stillness of the night," as Mr. Audubon describes it. This bird is easily subdued and domesticated, insomuch that, if set at liberty, it will return to its cage. Its song is not impaired by captivity. Great care, however, is requisite for its preservation from the effects of cold, a constant summer temperature being essential.

REED-BIRD, OR BOB-O-LINK.

[PLATE XXVII.]

Emberiza oryzivora, WILSON.
Icterus agripennis, BONAPARTE and AUDUBON.

DESCRIPTION.—Length, 7½ inches; alar extent, 11 to 12 inches; upper part of head, wings, tail, sides of neck, and lower parts, black; feathers, frequently skirted with brownish-yellow; back of head, yellowish-white; scap-

ulars, rump and tail-coverts, white, and all, except the first, tinged with ash; tail-feathers, sharp at end; iris, hazel; bill, bluish-black, but in the female, young bird, and autumn male, pale flesh-color.

The "Meadow Bird," in Louisiana, the "Reed Bird," in Pennsylvania, the "Rice Bunting," in the Carolinas, and the "Bob-o-link," in New York, and thence eastward, are all the same, and yet of very different characteristics in the different regions. Entering the Southern portions of the United States, it proceeds northward in early spring, flying by night; but, returning in the autumn, it flies by day. It reaches New York by the middle of May, having inflicted much injury upon the corn-fields of the South in its journey, but is believed to do little or no injury in the North. At this season, it becomes so plentiful all over the country as to be found in pairs in every corn-field and meadow, their varied plumage and joyous song everywhere attracting the desires of bird-catchers, who capture them in trap-cages, and sell them for good prices in every city. They are sometimes taken to Europe, and, in such cases, the change in the hue and the cessation of the song of the male, by the time the journey is over, often disappoints the adventurous shipper. In captivity, they are easily tamed, but appear cheerful only in spring and parts of the summer, though the song is never so glad as when the bird is free. When thus confined, their food, in spring and summer, should resemble as nearly as possible that which they obtain for themselves when at liberty; but in winter, they should be fed on rice boiled in milk, or millet, Canary-seed, wheat bread soaked in water, and minced animal food, without salt or other seasoning.

The song of the reed-bird, and its imaginary colloquys, are familiar to all. But this proneness of the male to sing ceases about the first week in July, when his variegated dress is being changed to brownish-black, that of the female changing at the same time to brownish-yellow. Thenceforth, a little *chink*, when surprised, is the only sound they utter.

During their sojourn in Louisiana, as elsewhere, in spring, their song is extremely interesting, and emitted with great volubility. After feeding for a while upon the ground, they fly to a tree or copse, where one first leads off in song, and is promptly followed by thirty or forty others, producing a cheering and agreeable, yet ludicrous medley, and anon ceasing with singular abruptness. In the love-season, when the males are more sprightly than ever, they sing gaily while upon the wing, rising and falling in the air.

The frail nest of the reed-bird is placed on the ground, with little apparent care as to choice of situation, but always among the grass, or in a field of barley. It is comparatively large, and composed externally of coarse, dried grass and leaves, and internally lined with finer meadow-grass and feathers. The eggs are from four to six in number, white, strongly tinged with dull-blue, and irregularly spotted with blackish. The male guards the nest during the period of incubation, and is ingenious in decoying from it any

intruder. But one brood is reared in a season, and the whole family associate with others in large flocks by the end of July. Numbers seem even then to be leaving the Eastern States, and they all retire to the borders of rivers and estuaries to perch. The song of the male has subsided by the time the young are hatched, and he has now come forth in sober russet. This is their season of greatest destructiveness, when they congregate in multitudes, not only to devour the seeds of wild grasses and reeds, but, in the South, to consume and destroy vast quantities of rice, also; but it is likewise the season in which they are slain in countless numbers, by wary gunners, who seek them at sunset on pleasant evenings, in the midst of full-grown reeds near the sea-shore, or by the margins of rivers, where they retire to eat of the ripe seeds, and to roost. Their flesh is juicy and tender, and they are much sought after; yet, from the myriads that invade and rob the rice plantations, it seems incredible that the work of slaughter has ever been practised against them.

RED-WINGED STARLING.

[PLATE XXVIII.]

Sturnus prædatorius, WILSON.
Icterus phœniceus, BONAPARTE, AUDUBON, and NUTTALL.

DESCRIPTION.—Male, 8½ to 10 inches long; glossy-black, except lesser wing-coverts, where lower rows of feathers are reddish cream-color, the rest bright-scarlet; legs and bill, black; iris, hazel; tongue, nearly long as bill, slender and torn at end. Female, 8 or 9 inches long; throat and below, thickly streaked with black and whitish, or cream-color; under the throat, sometimes pale-reddish; above, black, feathers edged with pale-brown, white or bay. Young male, black; shoulder, color of red-lead, fading at the edges into buff-yellow; above, feathers edged with brownish-ferruginous and brownish-white, except the rump, in which the feathers are faintly edged with cinerous; over the eye-brows, a pale line; beneath, from the chin downwards, black, the feathers edged with greyish-white. The size and markings greatly vary.

The red-winged starling, or red-shouldered marsh-blackbird, is quite distinct from the starling of Europe. It is dispersed over the whole of the United States, the fur countries, the great Western plains, the Rocky Mountains, and even the shores of the Columbia River; and it is said to breed in great numbers in every part of these regions.

In early spring, before the snow is all gone, almost all of these birds leave the Southern States in small and straggling flocks, the males leading the way in full song, as if to invite the females to follow. These migrations are performed during the day, the birds frequently alighting on trees, spreading their tails, swelling out

their plumage, and uttering their clear and not unmusical *con-quer-ree*, particularly in the morning before departing from the vicinity of the roosting-place of the preceding night.

At this season, their food consists almost exclusively of grubs, worms, caterpillars, and various sorts of coleopterous insects, found with difficulty in meadows, orchards, and newly-ploughed fields. In this pursuit, they move more gracefully and quickly than either the purple-grackle or the "boat-tail" of the Southern States; and the destruction in this manner of millions of insects is by some regarded as an equivalent for the corn they subsequently consume. The ploughman, therefore, so far from molesting them, permits them to follow the plough unharmed, in company with the crow-blackbird.

On the arrival of the females, groups of males pursue each one until her choice is made, when the pair select a place for their nest in some sequestered swamp or damp meadow, upon an alder bush or thick tuft of weeds. Coarse, dried weeds form the exterior, and fine grass, and sometimes horse-hair, the interior. The eggs are from four to six in number, of regular oval form, light-blue, sparsedly marked with dusky spots. Here the male protects his nest with great courage, flying near the intruder, and lifting his voice in remonstrance or complaint.

The first brood comes forth about the 1st of June, and the second, the beginning of August. They are now very destructive, especially in the waste of corn; and the farmers use every means in their power to kill them or frighten them away; but "scare-crows" have no terror for them. When the corn begins to harden well, they resort to the meadows and margins of streams, and subsist upon wild-oats and other grasses, as well as various seeds; and anon associating partially with reed-birds, grackles, and cow-pen buntings, and receiving accessions to their numbers on the journey, they move to the Southern States in such dense flocks as almost to cloud the air. At this season, they annoy the grain-grower and rice-planter by levying heavily upon their crops, and numbers may be shot at each discharge of a gun, and hundreds bagged in a few hours; but they are no better food than the starling of Europe, or the crow-blackbird of the United States. The people in the country, however, often relish them in pot-pies.

Towards evening, thousands may be seen to alight in compact bodies on weeds and rushes, just above the water, to remain during the night. If disturbed by a gunner, they will rise and perform various evolutions in the air, but return to their former perch, and again endeavor to repose. They are often the prey of hawks, especially the pigeon-hawk, and the hen-harriers of the South.

This starling is easily kept in captivity, and sings with as much vigor as when at liberty, feeding upon rice, wheat, or other small grain; but it will not breed in confinement.

ORCHARD ORIOLE.

[PLATE XXIX.]

Oriolus mutatus, WILSON.
Icterus spurius, BONAPARTE, AUDUBON, and NUTTALL.

DESCRIPTION.—Length of male, 6½ inches; alar expanse, 9 inches; bright-chestnut; head, neck, back, wings, and tail, black; bill and legs, bluish-black; iris, hazel; in third year, mottled on upper parts of back with black and olive; and on belly, sides, and breast, reddish-grey begins irregularly to appear, blended with yellow; and generally two middle feathers of the tail are black, others centred with same color. Female and young of one year, yellow-olive, inclining to brown; beneath, yellow; wings and tail, dusky-brown. Young male of more than one year, same, but throat, black.

The orchard oriole enters the Southern States from South America early in March, and continues there until October. In the more northern regions, it of course arrives later and departs earlier; but it does not often go further north than Connecticut. The migration from south to north is performed by day, and singly, the males preceding the females by a week or ten days, frequently alighting on the top of trees, to rest or feed. They exhibit a great repetition of motions of the wings, although gliding through the air for a few yards only at a time, and, while about to alight, as well as afterwards, perform strong and well-marked jettings of the tail.

As soon as they reach the portion of the country in which they intend to remain during the time of rearing their young, and where they are always welcomed with pleasure, these birds exhibit all the liveliness and vivacity belonging to their nature. The male is then seen rising in the air 10 or 20 yards in an indirect manner, jerking his tail and body, flapping his wings, and singing his song of *cheery, cheery, cheery* with remarkable impetuosity, and soon descending with the same motions of the body and tail, repeating his pleasant song as he alights. It is equally lively and expert in its pursuit of insects and larvæ upon the trunk of a tree or on the ground beneath. A little time is consumed before the female is won by her frisky wooer, the singing and gyrations of which are then very ardent; and, as soon as they have paired off, the most active industry is evinced. They resort to the meadows or search along the fences for the finest, longest and toughest grasses they can find; and, having previously fixed upon a spot, either on an apple-tree or amid the drooping branches of a weeping-willow, but which is very apt to be near the habitation of man, they begin by attaching the grass firmly and neatly to the twigs immediately around the chosen place. The filaments are twisted, passed over and under, and interwoven in such a manner as almost to defy the eye of man to follow their windings. All this is done by the bill of the bird. The nest

is hemispherical, and supported by the margin only, being 3 or 4 inches deep, open almost to the full extent of its largest diameter, and finished outside and in with long slender grass, some of which goes around the nest several times, as if closely woven. But softer and warmer materials are used in the more northern ranges of these birds. The eggs are from four to six, of a bluish-white tint, sprinkled with dark-brown. But one brood is raised in a season. The young follow the parents for several weeks, and many birds congregate towards autumn; but the males soon depart for the South as they came, in advance of the females.

Figs, mulberries, strawberries, and various kinds of fruits are eaten by these birds, but not to a very injurious extent, their chief reliance being upon the pernicious insects of the garden and field. Individuals have been preserved in aviaries for several years, retaining the summer hues of their plumage throughout the winter

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CROW-BLACKBIRD

[PLATE XXX.]

Quiscalus major, BONAPARTE, AUDUBON, and NUTTALL.

DESCRIPTION.—Length, 12 inches; alar extent, 18 inches; glossy-black, relieved by glossy reflections of steel-blue, dark-violet, and green; violet most conspicuous on head and breast, and the green on the hind-part of the neck; back, rump, and whole lower parts, except breast, reflect a cupreous gloss; wing-coverts, secondaries, and coverts of tail, light-violet, with much of the red; rest of wings and rounded tail, black, with steel-blue gloss; iris, silvery. Female, a little smaller and less brilliant.

The crow-blackbird, or "Boat-tailed Grackle," is an inhabitant of the Southern States, to the maritime portions of which it is more particularly attached, seldom going more than 40 or 50 miles into the interior, and then following the swampy margins of large rivers, as the Mississippi, Santee, St. John's and the Savannah. Though it is found in Louisiana, it does not ascend as far as Natchez. It abounds in the southeastern low grounds of Florida, and in those of Georgia and South Carolina, as well as on the Sea Islands of the Atlantic coast, as far north as the Carolinas, beyond which none are to be seen.

The boat-tailed grackles are gregarious at all seasons of the year, and are often seen in very large flocks. They seek for food among large salt-marshes and their muddy shores, and in rice plantations, as soon as the grain is fit to be eaten by them. In autumn, they resort not unfrequently to corn-fields, and ploughed lands of plantations, interspersed with ponds or marshy places, retiring towards evening to the salt-marshes, where they perch in immense flocks amidst the tall marsh-grass, (*Spartina glabra*,) from which their

cries are heard until darkness comes on. Their food consists principally of the small fiddler crabs, of which myriads are found along the margins of the rivers and muddy flats, and of insects of various kinds, ground-worms, and seeds, especially grain. They frequently seize on shrimps, and other aquatic animals of a similar nature, which have been detained at low tide on the banks or on "Raccoon oysters," a kind of shell-fish, so named under the idea that it is eaten by the raccoon. In autumn, while the rice is in the stack, they do much mischief, though less than when it is in the juicy state; they also then consume corn and other grains.

Mating about the beginning of February, many of them begin their nests at this early season, the plumage of the male displaying its richest gloss; the tail, which after the breeding season is no longer navicular, is deeply incurved toward the centre, and his port is proud and spirited. Though jealous and belligerent at this period, as soon as assured of the affection of his chosen mate, he becomes mild and placable. Inaccessible islands and other marshy spots are chosen for their breeding-places. Their nests are often built quite near each other, upon branches of the smilax, the nest of a former season always being reclaimed by its former occupants, which repair it; but a new one is promptly constructed of the long-fibred Spanish moss, that dangles from every tree, dry twigs, withered grass, and dead leaves; the lining of the nest is composed of such thready roots as are found in such situations. Here the females deposit from three to five eggs, which are $1\frac{3}{8}$ inches long, and seven-eighths of an inch broad, and patiently hatch them, and nurture their young, uncheered and unassisted by the males, which desert them as soon as the season of incubation commences, and renounce all care and responsibility with respect to their young. But one brood is reared in each season, and the young are able to follow their mother on the wing by the 20th of June, the period of their laying being about the 1st of April. Their squabs are regarded by sportsmen as excellent eating; and, when hatched upon the tall reeds in the regions of the alligator, they are often devoured by them, at the approach of which, however, they usually fly away in terror to escape.

The flight of the grackles is high and protracted, in decided undulations of 40 or more yards. They move in loose flocks, uttering the cry of *kirrick-crick-crick*. In autumn, or as soon as the females and their broods associate with the males, their movements are regular, from south to north, while returning towards their perching-places, and the reverse in the morning, when going out to look for food. They are shy and wary.

Probably a third of these birds, in the Carolinas and Georgia, remain during the winter, associating with the fish-crow, alighting on stakes, in the mud-flats near the cities. They are also fond of the company of cattle, walking among them in the manner of the cow-bunting. But they never enter the woods. On the ground, they walk in a stately and graceful manner, the tail being elevated and jetting at each chuck.

The males frequently attack birds of other species, driving them from their nests, and sucking their eggs. When wounded, if not disabled, they retreat with alacrity; when overtaken, they defend themselves by biting and scratching, often causing the blood to flow from the hands of their captor. They are courageous and formidable, not unfrequently giving chase even to turkey-buzzards, and hawks.

PURPLE-GRACKLE.

[PLATE XXXI.]

Quiscalus versicolor, AUDUBON and NUTTALL.

DESCRIPTION.—Length, 11½ inches; expanse of wings, 17¼ inches; tail, long and much rounded; feathers, flat; plumage, silky and splendent; head, neck, and anterior part of breast, blackish, with vivid reflections of violet, steel-blue and green; general color of the body, dusky, glossed with purple, green and blue—these colors arranged in three terminal zones on each feather; rump, violet-purple; wings and tail, black, glossed with green and blue. Female, smaller; body, more brown; reflections, less brilliant.

The purple-grackle, or common crow-blackbird, is well known on the sea-board from Louisiana to New England, as an active, energetic bird. It is found in large numbers, at all seasons, in the former State, whence many of them proceed northward about the middle or last of February, and arrive in New England from the middle of April to the 1st of May. In Louisiana, they follow the ploughman as he turns the furrow, and seize upon the grub before it can escape from the light. Their silky vesture of varying hue—coppery bronze, brilliant and deep azure, refulgent sapphire or emerald-green—and their stately walk and graceful flutterings, excite his admiration, while the destruction of each worm is the removal of an enemy of the cotton, corn, or sugar-cane; but when they afterward demand a small share of these crops in compensation for the protection they have given, the planter, regardless of the welcome service they had rendered, is merciless in repelling their demands, following them with his gun and killing large numbers, yet without effecting any apparent diminution, or intimidating and dispersing the multitude of depredators.

The season of love having arrived, and the male having won his mate by the exhibition of valor and assiduity, the pair select a safe and agreeable retreat, usually in a hole or cavity of a lofty dead tree standing alone in an open field. Here a few dry weeds and feathers are deposited, when the female lays her eggs, from four to six, of bluish tint, blotched and streaked with brown and black. She sits upon them while her valiant mate and guardian mounts to the summit of a broken branch, pours forth his rude notes, and

cheers and watches her with the kindest and most unremitting care. The red-headed or golden-winged wood-pecker, having the temerity to approach this vicinity, is repelled and discomfitted with great promptness. The male is also energetic in the pursuit of food, placing before his mate many delicious repasts of grubs and grains of corn; and when the young emerge from the shells, both parents cherish them with great care.

In September, these birds begin to retire from the Eastern States, and on reaching Louisiana, about two months later, they congregate in prodigious flocks, and rejoice in chorus over the delights of the still lingering autumn, regardless of the assaults made upon them by the covetous gunner, who finds no difficulty in bringing scores of them to the ground in a very short time. Beech-nuts and acorns are at this season their food, which they seek in flocks, making a great flutter and noise when disturbed; but in the winter, they frequent the farms, and even among the refuse straw and litter of the cattle-pens pick up the scattered grain. They are then easily caught in traps, and evince but little fear of their captors, whom they fight with bill and claw. Although they do not destroy other birds, when at liberty, they have been known to become ferocious in the cage, not only killing doves, pigeons, and cardinal grosbeaks, but even the weak of their own race.

In flying, they slightly ascend with each effort of their wings, and descend as the force of this propulsion is becoming exhausted, thus moving in a continuous undulating line, keeping up a lively chattering all the way. In the North, their nests are better made than has been described in relation to the South. The dense foliage of a pine is here preferred, and the nest, though more bulky, is not unlike that of the robin, (*Turdus migratorius*,) except that several of them, sometimes a dozen or more, are located in the horizontal arms of a pine, tier above tier. The centre of the nest is saddled on the bough, being made thinner in the part resting thereon. It is about 6 inches in diameter outside, and 4 inches within, the depth being the same. It is composed of grass, slender roots, and mud, and is lined with hair and the finer grasses. An erroneous impression prevails in Pennsylvania and probably elsewhere, that they pull up the garlick in the fields. Planters, in Louisiana, sometimes steep their seed-corn in a solution of Glauber's salt to prevent its being eaten by the purple-grackle, as soon as planted, which is probably their most mischievous practice in the North also. The eggs of this bird are good to eat; but, though their flesh is eaten by many, especially in pot-pies, it is really little better than that of the crow.

COMMON CROW.

[PLATE XXXII.]

Corvus corone, WILSON, BONAPARTE, and NUTTALL.
Corvus americanus, AUDUBON.

DESCRIPTION.—Length, 18½ inches; alar expanse, 38 inches; black and glossy, with violet-colored reflections; tail, somewhat rounded, extends beyond wings, with acute feathers; fourth primary, longest; first, equal to ninth; bill and feet, black; iris, hazel. Female, smaller; reflections of plumage, less lively, varies sometimes to yellowish or whitish-grey; occasionally plumage varied with feathers; sometimes a part of the body, white or rufous-grey.

The American crow is very generally distributed from the Gulf of Mexico to the Columbia River, throughout the interior, and along the coast, to latitude fifty-five degrees and congregates in immense numbers in the Southern and Western States during winter. Wherever they are found, they are persecuted and destroyed by man, with guns, traps, and poisons, and this regardless of the vast benefits they confer in the destruction of myriads of grubs, and innumerable quadrupeds inimical to poultry and flocks. They are consequently fearful of man, and wonderfully adroit in evading his pursuit. They evidently know his weapons of destruction, and flee from him the more promptly when these are exhibited. A sentinel upon the summit of a lofty tree, who has been observed to be regularly relieved, is faithful to duty, giving timely warning of the approach of danger, and being himself the last to effect a retreat. Perhaps, no other species of the feathered tribe has so taxed the ingenuity of man to compass its destruction. Its depredations upon the sprouting corn, in spring, suggest all kinds of snares and traps, and of devices to frighten it from the fields. As it is known to be very cautious and suspicious, every manner of deception is used to take advantage of this trait of its character, and to induce it to think that its safety depends upon its keeping clear of the specious sham-traps set for it. Hence corn-fields are strung round with twine stretched from pole to pole beneath effigies of men and boys; miniature wind-mills are erected on poles, or pieces of tin or glass are suspended to dangle in various parts of the field. But, when the crows have once got a taste of the corn, they defy all these appliances, though the exhibition upon a pole of one of their own species slain, is not without effect in deterring them from depredations. As a means of capturing individuals for this purpose, resort is sometimes successfully had to the use of corn, steeped in sweetened whiskey or rum, which they eat freely, and, when becoming intoxicated, they fall an easy prey to their enemies.

The presence of this bird, however, is by many regarded as a proof of its usefulness, and its destruction is by such persons deemed

unwise, the service it renders being supposed to be far greater than the depredations it commits in gratifying its appetite for fruits, seeds, and vegetables of every kind. Snakes, frogs, and lizards, various, species of worms, and grubs, insects, and putrid carrion, when pressed with hunger, constitute a portion of its food. It is also fond of the eggs of other birds, and in anger will break in the skull of a weak or wounded bird, and delights in annoying its twilight enemies, the opossum, raccoon, and the owl, and will even follow, by day, a fox, wolf, panther, or any other carnivorous beast, seemingly to share the prey of such animal, or to devour it when man has slain it; and though it plunders the fields of their superabundance, it yet protects the poultry of the farm-yard from the depredations of the thieving hawk. After a severe winter, however, it has been known to pluck out the eyes and destroy very young lambs in the spring.

The breeding-place of the American crow, Mr. Audubon says, is selected with great care, in the interior of dismal swamps, or on the sides of elevated and precipitous rocks, almost always admirably concealed from the eye of man; but I have never found it so very cautious. On the contrary, in the Northern sections of the Union, they generally build their nests in the margin of the forest. They select for the purpose lofty trees, from which they can see a great distance, and seemingly watch the operations of the farmers around them. Several pairs build in the neighborhood, and when any domicil is molested, they make a common cause of it, and manifest their sympathy by a union of voices and forces. They breed in almost every portion of the Union, and probably westward to the Pacific. The period of nestling varies from February to the beginning of June, according to the locality. Their scarcity on the coast of Labrador suggests a doubt to Mr. Audubon of their identity with the carrion-crow of Europe. The nest, however, resembles that of the European crow, being formed externally of dry sticks, interwoven with grasses, and thickly plastered with mud or clay within, and lined with fibrous roots and feathers. Three eggs, or sometimes four, are laid by the female, and both sexes incubate, their parental care and mutual attachment being unsurpassed by those of almost any other bird. Two nests are seldom or never found upon the same tree; yet they build in neighborhoods, and all fly out to protect any nest which happens to be disturbed. They become gregarious as soon as the breeding season is over, forming flocks of hundreds and even thousands. Towards autumn, of the individuals bred in the Eastern States, many remove to the South, to pass the winter, where they are fond of frequenting burnt grounds, and devouring the crisped remains of mice and other small quadrupeds, as well as lizards, insects, and snakes; but they retire to roost by the margins of ponds, rivers and lakes. Those which remain in the Northern States during the winter congregate in great numbers on the seashore, where they find abundance of food on the flats and beaches, when the tide is out, occasionally fishing up clams or other shellfish, which they separate from the shells with great skill. They

often become quite an annoyance to fishermen and fowlers, by pilfering the fish left on the shore or disturbing the wild fowl on the approach of the gunner.

Several individuals of this crow frequently pursue a hawk or eagle with remarkable vigor, and, at times, annoy the vulture; yet, it is believed, they never assail any bird with the view of preying upon it; but they will steal and remove, one at a time, all the eggs of a wild turkey's nest.

The gait of the crow, when on the ground, is elevated, sedate and graceful. It often alights upon the backs of cattle, to pick out the worms lurking in their skin. Its cry of *caw, caw, caw,* differs from that of the carrion-crow of Europe.

FISH-CROW.

[PLATE XXXIII.]

Corvus ossifragus, WILSON, BONAPARTE, AUDUBON, and NUTTALL.

DESCRIPTION.—Length, 16 inches; alar extent, 33 inches; glossy-black, violet reflections; chin, naked; eye, small; iris, dark-hazel; claws, black, sharp and long, hind one, largest; tail, slightly rounded, extending more than an inch beyond the folded wings; fourth primary, longest; first primary, much shorter than the ninth.

The fish-crow is confined almost entirely to the maritime districts of the Southern States, where it abounds at all seasons. Those which migrate proceed to the eastward about the beginning of April, and some go as far as New York, where, however, they are rather rare. They ascend the Delaware nearly to its source, and some breed in the State of New Jersey; but all return to the South at the approach of cold weather. Some ascend the Mississippi for a few hundred miles. In East Florida, they have been found to breed in February; in South Carolina, about the 20th of March; in New Jersey, a month later.

This species is gregarious; yet, as flocks of it sail high above the water, they appear to be paired off. These aerial excursions last for hours of a fine morning, after which the whole descend near the surface of the water, and fish for half an hour, when they alight on the trees near the shore, and keep up their gabble, pluming themselves for hours. Again repairing to the water, they fish until sunset, and then fly off 30 or 40 miles to roost on the loblolly pine, uttering scarcely a single note as they retreat; but on the approach of day, the woods echo to their matin cries of gratulation; and they promptly return to the sea-shore, noisy and happy, and are soon employed over the bays, rivers, wharves, salt-ponds and marshes, searching for any sort of garbage to appease the appetite. They do not scruple to rob other birds of their eggs and young, even watching the departure of the cormorant and white ibis from their nests, which they rob at the first opportunity. In the salt-marshes, they

catch and eat the small fiddler crab. They pursue with alacrity the smaller gulls and terns, which they compel to disgorge the small fish caught by them within sight of their oppressors. But the fleeter wings of the gulls often enable them to escape. They are able to catch fish alive with considerable dexterity; but cannot feed upon the wing, and are obliged to retire to some tree, stake, or sand-bank. They also seek on the backs of cattle for the larvæ which frequently are generated in their skin. In the winter and spring, they are fond of many kinds of berries, such as the cassena, (*Ilex cassena,*) holly, (*Ilex opaca,*) and the tallow-tree, (*Stillingia sebifera,*) a South Carolina tree of Chinese origin. As the mulberry ripens, they flock to it, and the fig-trees sometimes require to be guarded from their depredations. They are also fond of pears, and have been seen feeding on at least one species of smilax.

In Florida, Georgia, and the Carolinas, the fish-crow breeds on moderately-sized loblolly pines, (*Pinus tœda,*) making its nest about 30 feet from the ground, and towards the extremities of the branches. In New Jersey, where they are often killed in the company of the larger crow, they are more careful, and place their nests in the interior of the deepest and most secluded swamps. The nest is smaller and more neatly finished than that of the common crow, and is composed of sticks, moss, and grass, neatly finished or lined with fibrous roots. The eggs are from four to six, resembling those of the crow, but are smaller. It probably raises but one brood of young in a year.

The cry of this species, *ha, ha, hae* is like a faint mimicry of the common crow; at other times, it is more like an interrupted or half-stifled expression of pain. During the breeding season, the notes are much varied, and not disagreeable. The flight is strong and protracted, and at times very high. They also move gracefully on the ground, frequently expanding and contracting their wings. They may be approached and shot very easily; and when one is brought to the ground in this manner, its companions sail over it in numbers, and may be readily killed.

COMMON MAGPIE.

[PLATE XXXIV.]

Corvus pica, LINNÆUS.

DESCRIPTION.—Length, 18 to 19 and even 22½ inches; feathers of tail, unequal in length; bill, iris, and feet, black; secondaries, purplish-blue; the pie, sometimes varies to pure white, with a reddish iris, and is then an albino; the whole plumage, occasionally variegated with tints of rufous-grey or black; Buffon says it sometimes occurs wholly black.

Nuttall, Bonaparte, and Swainson regard the magpie of America and Europe as identical, and Audubon approves their judgment. Its range is general throughout Europe, but in this country it is

restricted to the western and northern regions. It is stated by Dr. Richardson that it has not been seen nearer to the Atlantic on this continent than the head of Red River, in Louisiana. It dwells in the fur countries of the North in winter as well as in summer, and is a common resident of the interior of Texas, Western Louisiana, Arkansas, and Missouri. It suffers from the want of food, but not from cold, in high northern latitudes, where travellers have been almost unable to protect their galled horses from its assaults. Unlike the magpie of Europe, it then has little fear of man, the young especially coming to his encampments or habitations, and greedily devouring whatever food they can obtain, even from his hands. The raven is often its companion, but the crow is not found with it.

In the central table-land of the Rocky Mountains, the nests of the magpie may be seen, usually in low, thick bushes, barricaded over and floored with interlaced twigs; and it is common also near Monterey, in California. Its common call is *pay*, *pay*. When approaching each other, they practise a low chatter, but utter a monotonous and gluttonous croak while eating.

The account of the habits of the European magpie, given by Macgillivray, is recited by Audubon in treating of the American bird. He states that its food consists of testaceous molusca, slugs, larvæ, worms, young birds, eggs, small quadrupeds, carrion, and sometimes grain and fruits of different kinds, in search of which it frequents the fields, hedges, thickets, and orchards; it occasionally visits the farm-yard, prowls among the stacks, and perches on the house-tops, whence it sallies to examine any attractive spot. It is probably unjustly accused of picking out the eyes of lambs and sickly sheep; but it eats eggs, or the young of chickens or ducks, when the old are not present to repel it. Its more wary character, in Europe, is the result of the persecution it experiences because of its depredations.

The magpie walks like the crow, but often leaps in a sidelong manner. It is prompt to apprize its companions of the approach of danger, which it does by a chatter indicating its own fears.

The eggs of this species are from three to six in number, and vary in form and color. In general, they are regularly ovate, or a little pointed, more than 1½ inches in length, and nearly or quite an inch across. They are frequently pale-green, freckled all over with umber-brown and light-purple, and sometimes pale-blue or bluish-white, or greenish-white, with smaller spots and dots of the same dark colors, so as very nearly to resemble the eggs of the jay, which, however, are smaller.

BLUE-JAY.

[PLATE XXXV.]

Corvus cristatus, Wilson, Bonaparte, Audubon, and Nuttall

Description.—Length, 11 inches; crest, pale-blue; narrow line of black along the frontlet, higher than the eye, but not over it; collar of black, forming crescent on heart; back, and upper parts of neck, fine light-purple, blue predominating; chin, cheeks, throat, and belly, white, with some blue, except in the last; greater wing-coverts rich-blue; coverts and secondaries, barred with crescents of black, and tipped with white; tail, of twelve feathers, long and wedged, glossy bright-blue, marked at small intervals with transverse curves of black, each feather, except the two middle darker ones, being tipped with white; breast and sides, under the wings, greyish-white, tinged with vinaceous; mouth, tongue, bill, legs, and claws, black; iris, hazel.

The blue-jay or "Corn Bird," as it is called in some localities, breeds in all parts of the United States, except portions of Florida, perhaps, where it gives place to the Florida jay. The Canada jay also somewhat circumscribes its range in that direction, though Richardson says it may be seen in the fur countries in summer up to the fifty-sixth parallel of north latitude. Some of them remain as far north as Maine in winter. They are more abundant in mountain ranges than elsewhere, generally frequenting the margins of pine and oak forests. In South Carolina, they prefer to build upon the live-oak; in Louisiana, they are less shy, and build very near the habitations of man. They sometimes take possession of the old or abandoned nests of the crow or the cuckoo. South of Pennsylvania, they breed twice a year, and northward and eastward but once, which is in May or June. Their nests are composed of twigs and other coarse materials, lined with fibrous roots, and are placed upon trees or scrub-oaks a little higher than a man's head. The eggs are four or five in number, of a dull olive-color, spotted with brown.

The blue-jay is omnivorous, feeding indiscriminately upon all sorts of flesh, seeds, and insects. It is more tyrannical than brave, and, like most boasters, domineers over the feeble, dreads the strong, and flies even from its equals. It is, in fact, a downright coward. The cardinal grosbeak will challenge it and beat it away; the red-thrush, the mocking-bird, and others inferior in strength, never allow it to approach their nests with impunity; but, mean and thievish as it is beautiful, it watches for their departure, creeps to their nests, and steals and devours their eggs. When disturbed in its depredations, it starts up, flies for the woods, and cries *kay, kay, kay, kay,* and on reaching the covert and feeling safe, it shouts in an exulting tone *coogle, coogle, coogle, coogle, coogle, coogle.* But, on returning to its own home, however, it not unfrequently finds its mate in the jaws of a snake, its eggs devoured, and its nest destroyed

—a severe but just penalty for the selfishness, duplicity, and cruelty it practises towards all others. In robbing every nest it can find, it sucks the eggs like the crow, or tears to pieces and devours the young birds. A pair of them has been known to pick out the eyes of a wounded grouse, (*Tetrao umbellus*,) before the sportsman could get to it. A flying squirrel confined in the cage of one of them for a night, also became its prey. All the birds of an aviary have been known to be successively destroyed by it, even to the Key West pigeon, the rats being in the mean time the suspected cause. Though feeding upon chestnuts, beech-nuts, pecan-nuts, grapes, fruits of various kinds, and corn, when at liberty, when caged it evinces a very decided preference for the flesh of birds or fresh beef. It is exceedingly fearful when first caught, but in a day or two usually becomes reconciled to captivity and is quite sprightly.

In Louisiana and some other regions, this bird is so abundant as to prove a great annoyance to the planter, picking up the newly-planted corn, peas, and sweet potatoes, attacking the fruit-trees, and destroying the eggs of pigeons and domestic fowls. They are often killed by corn thus obtained, which has been soaked in a solution of arsenic before planting, for this purpose. They may be captured in snares and box-traps, or by means of bird-lime, made by boiling linseed oil to a thick consistency with which straw is smeared, and then spread upon the ground where they are baited. In the winter, they stealthily feed with the barnyard poultry, and participate in all the advantages of the familiar walks of these fowls. In their migrations, which are performed in flocks and by day light, and in pursuit of food rather than change of temperature, they frequently alight to feed upon chinquapins, wild chestnuts, acorns, or grapes. At this season, they are very garrulous, especially if disturbed and pursued, unless a hawk be the pursuer, when they become silent, and sneak quietly away to the thicket, and there remain until the foe has passed by. In the fall, these birds denude the corn of its husks, consume or carry off much of it, and leave the rest thus exposed to be devoured by depredators of less energy or skill than themselves. What they carry off they hide in the crevices of the bark of trees, chinks of the limbs, and elsewhere; but the search for these deposits, in the season of want, is generally attended with but limited success.

GREAT AMERICAN SHRIKE.

[PLATE XXXVI.]

Lanius excubitor, Wilson and Audubon.
Lanius septentrionalis, Bonaparte.

Description.—Length, 10 to 10½ inches; alar expansion, 13 to 14 inches; above, pale-cinerous; sides of head, nearly white, crossed with a bar of black, from the nostrils through the eye to the middle of the neck; beneath, sometimes nearly white, at others inclining to dusky, and marked thickly with

varied lines of darker hue, each of the feathers marked with two or three rounding transverse bars; wings, black, spot of white on primaries below coverts; rump and tail-coverts, light-ash; tail, cuniform, of twelve feathers, two middle ones only black, (in the young four,) others tipped with white, outer pair, nearly all white; legs, feet, and bill, towards its point, black; iris, bright-hazel. Female, paler, band of black on face, obscure. Young, greyish-drab, wing-spot obscure; third and fourth primaries, nearly equal, second, much shorter; four middle tail-feathers, wholly black.

The great American shrike, or "Butcher Bird," spends most of the year in the Eastern States, and in countries still further north; yet many pairs of them remain and breed in the mountainous districts of the Middle States; and, in severe winters, they migrate as far south as Natchez, on the Mississippi. They are never seen, however, on the coasts of the Southern States. In spring and summer, they retire from the low-lands of the Middle States to the mountainous districts, where they generally remain until autumn. About the 20th of April, they build their nests in covered and secluded parts of the forests. These nests are often found on shrubs not above 10 feet from the ground, and generally in a fork at the top. They are as large as those of robins, and are composed externally of coarse grass, leaves, and moss, and internally of fibrous roots, over which feathers of the wild turkey and pheasant (*Tetrao umbellus*) are placed. The eggs are four or five in number, of a dull cinerous tint, thickly spotted and streaked with light-brown towards the larger end. The period of incubation is fifteen days. The young, so unlike their parents for a time, remain long with them, sometimes, indeed, even during the first winter. Caterpillars, spiders, and insects of various kinds form their first food, together with small fruits; but, as they grow up, their parents bring them the flesh of small birds, on which they feed greedily even before they leave the nest.

Possessing the faculty of imitating the notes of sparrows and other birds, especially their cries of distress, they are believed to allure birds of these species and then seize upon them. One of them will alight upon its prey, strike it on the back of the head, which it thus breaks open, and, if not interfered with, will tear up the body, and swallow it in large pieces, with many of the feathers upon it. This shrike often pursues a turtle-dove or other bird a long distance on the wing, and eventually, by a single blow, causes it to fall to the ground. It is always active, courageous and persevering; and in winter, when insects and small birds are scarce in the Eastern States, at times, it enters the cities, and attacks birds in cages, even flying through the opened doors and windows in the pursuit. When caught with the hand, it pierces its little claws into the flesh and bites with considerable tenacity until choked off.

The flight of this bird is strong, swift and sustained, but not very elevated, being simply over the tops of low bushes. Impaling insects and birds on thorns is among its acts of cruelty, a habit it pursues without apparent motive, though some believe its design in this is to attract small birds to the spot, that it may seize and prey upon them.

HAIRY WOOD-PECKER.

[PLATE XXXVII.]

Picus villosus, WILSON, BONAPARTE, AUDUBON, and NUTTALL.

DESCRIPTION.—Length, 9 inches; alar extent, 15 inches; crown, black; wings, black, tipped and spotted with white; beneath, white; the two exterior feathers of the tail, terminating in umber tint; legs and feet, greyish-blue; bill, bluish horn-color, straight, about 1¼ inches long. Male, red occipital band; female, same black.

The hairy wood-pecker has been confounded, with the Canada wood-pecker, (*Picus canadensis*,) which it nearly resembles. The latter inhabits the State of Maine, where the hairy wood-pecker is rarely seen, and never in the interior; but the former is a constant resident both in the maritime and inland districts, from Texas, where it abounds, to New Hampshire, as well as in well-wooded districts between the junction of the Missouri and Mississippi, and the northern borders of the great lakes. This species is lively, noisy and fearless of man, and may be seen in the South at all seasons in orchards, among the trees of cities, along the borders of plantations, on the fences, on isolated fields, and in the densest forests; and is even found in the salt-marshes at the mouths of the Mississippi, where a straggling cotton-tree or willow affords an opportunity for the exercise of its skill in boring. It recedes from the North at the commencement of winter, to return again with the flowering of the apple.

In most parts of the Southern States, it is quite familiar in winter, and comes boldly to the barn-yard to glean its food, but is not regarded as very destructive or rapacious. Attempts to catch it in its nest, or elsewhere, by means of a net, are rarely successful, its skill in excavating a passage being almost always adequate to its escape.

RED-HEADED WOOD-PECKER.

[PLATE XXXVIII.]

Picus erythrocephalus, WILSON, BONAPARTE, AUDUBON, and NUTTALL.

DESCRIPTION.—Length, 9½ to 10 inches; alar extent, 17 inches; bill, light-blue; legs, bluish-green; iris, dark-hazel; head, neck, and throat, crimson; back, wings, and tail, black, with bluish reflections; secondaries, rump, lower part of the back, and under parts of the body, white. Female, less brightly colored; young, head and neck, dull-grey, varied with blackish.

The red-headed wood-pecker is well known throughout the United States. In the spring and summer, it is seen in every region; and

in the winter, it continues in some of the Southern States, though the greater number migrate much further to the south from the latter part of September to the middle of November. In very mild winters, however, individuals have been known to linger as far north as Massachusetts. The exodus is at night, when they fly far above the trees in as great disorder as a disbanded army, propelling themselves by repeated flaps of the wings, at the end of each successive curve which they describe in their flight, and emitting a single sharp sound, that may be heard upon the ground, though they are out of sight. At early dawn, they alight on the tops of dead trees and pass the day in rest and the pursuit of food. Their return northward is in Pennsylvania about the 1st of May. About the middle of that month, they prepare their nests in the large limbs of trees, adding no materials to the cavity which they smooth out for the purpose. Sometimes, several perforations are found in the same tree; but living trees are seldom occupied by them. The same tree is employed for years in succession by a pair of these birds. The eggs, usually six in number, are white, marked at the largest end with reddish spots, in which last particular they differ from all others of the genus. The first brood appear about the 20th of June. Both the eggs and young of this, as of many other birds, often fall a prey to the common black-snake.

The mocking-bird alone exceeds this wood-pecker in gaiety and frolic. It everywhere finds abundance of food and facilities for raising its broods. It is not much afraid of man, and will retreat but a short distance at a time from him, or even simply run around a tree or stalk, and peep from behind it at him; and this notwithstanding that man is its most dangerous enemy. So abundant and fearless are they at times that a hundred have been shot in a day upon a single cherry-tree; for they not only feed upon the ripening fruit, but destroy immense quantities, even to the stripping of them. Pears, peaches, apples, figs, mulberries, and even peas are thus attacked. The corn, also, both when young and juicy and when near maturity, is a subject of their depredations. They also invade the abodes of pigeons, martins, and other birds, for the purpose of sucking their eggs. When their hunger is satisfied they are exceedingly playful, chasing each other from tree to tree in curving sweeps, or following insects upon the wing. When they alight upon the ground, they are quite agile, securing with ease the beetles seen from their perch. When the fruit is all gone, their facility in detecting insects under the bark of trees is remarkable. Alighting upon the trunk, one of them will stand motionless for a few moments; then he will strike the tree with his bill, and again listen, until he hears the motion of an insect or larva within, when he perforates the bark and devours his prey. In the season of ripe fruits, their flesh is esteemed by many as rich food.

As a means of protecting fruits, a bare pole is placed beside a tree, and reaching a little higher than its summit. Upon this the bird alights by preference, when a blow given to the pole below will produce such a vibration as will cause the bird to fall dead.

In the Southern States, two broods of this species are reared in a year; in the Middle States, seldom more than one.

GOLDEN-WINGED WOOD-PECKER.

[PLATE XXXIX.]

Picus auratus, WILSON, BONAPARTE, and AUDUBON.

DESCRIPTION.—Length, 12 inches; alar extent, 20 inches; back and wings above, umber-color, transversely barred with black; upper parts of head, inclined to cinerous; cheeks and around the eye, cinnamon-color; throat and chin, lighter tint; from lower mandible to throat, a strip of black; crimson crescent on the hind-head; sides of neck, bluish-grey; black, broadish crescent on breast; below, yellowish-white, each feather with a distinct round central black spot, those on the thighs and vent, heart-shaped; lower side of wing, tail, and shafts of most of larger feathers, golden-yellow; rump, white; tail-coverts, white and curiously serrated with black; upper side of tail and tip below, black, the two exterior feathers serrated with whitish; shafts, black towards tips, two middle almost wholly so; bill, 1½ inches long, dusky horn-color; legs and feet, light-blue; iris, hazel. The male has black mustachios: the young are dull-grey, without either the red or black crescent.

The golden-winged wood-pecker, called *Pic-bois jaune* in Louisiana, "Yellow Hammer," in New England, and "High Holder," "Yucker," and "Flicker" in other parts of the Union, being seldom known by the name of "golden-winged," employed by naturalists, may be said to be one of the least destructive of the birds regarded as injurious to agriculture. It is an inhabitant of all parts of the United States and of Canada, but is partially migratory from Canada and the Northern States, whence it proceeds to the South, in October, and returns to the North, in April, when its advent is announced by its *flicker*, *flicker*, *flicker*, *flicker*, which, at a little distance, is like the sound made by a mower as he whets his scythe. At all times animated and happy, these birds are peculiarly so at the love-making season of early spring, when their voices may be heard in the utterance of joyous sounds, and when the coy female is pursued by several males until she has indicated her preference, which produces no strife, as the rejected at once fly off elsewhere to woo. The song of the male, at this season, is not unlike a jovial laugh, nor by any means unmusical. As soon as mated, each pair immediately proceeds to excavate the trunk of a tree, and fashion a place for themselves and their young. The hole is at first made horizontal, and then downward about 6 or 8 inches. They caress each other on the branches, climb about and around the tree with apparent delight, rattle with their bills against the tops of the dead branches, chase away the red-heads, and feed abundantly upon ants, beetles, and larvæ. Before two weeks have passed, from four

to six semi-transparent eggs are laid. Two broods are thus produced in each season.

This species is scarcely less happy when domesticated in confinement than when enjoying the utmost freedom, feeding well, and finding amusement in everything, but especially in the destruction of wooden furniture, for which it has great capabilities.

The flight of this bird is strong and prolonged, being performed in a straighter manner than that of any other wood-pecker, though it propels itself by numerous beats of the wings, with short intervals of sailing in an almost horizontal direction. The migrations, which are but partial, are performed in the night, and are only known by the notes it utters and the whistling of its wings. The movements of one of them upon the side of a tree, or upon the ground, are very quick, though it only alights upon the earth to pick up a beetle, caterpillar, or other insect, or perhaps, a grain of corn. Apples, cherries, grapes, persimmons, raspberries, dogwood-berries, and even whortleberries and poke-berries afford it food at certain seasons; but the farmer's corn-crib is its granary in winter, despite of traps and scare-crows, though the farmer often makes his meal of it at these seasons.

Mr. Audubon says: "The young of this species frequently have the whole upper part of the head tinged with red, which, at the approach of winter, disappears, when merely a circular line of that color is to be observed on the hind-part, becoming of a rich vermilion tint. The hairy, downy and red-cockaded wood-peckers are subject to the same extraordinary changes, which, as far as I know, never reappear at any future period of their lives." This happens to both sexes. He further says: "This occurrence is the more worthy of notice, as it is exhibited on all the species of the genus, on the heads of which, when in full plumage, a very narrow line exists."

Raccoons and black-snakes are dangerous enemies to this bird. The former frequently puts one of its fore-legs into the hole where it has retired, and, if it be not too deep, draws out the eggs and sucks them, and often by the same means secures the bird itself. The black-snake contents itself with the eggs or young. Several species of hawks attack them on the wing, when the frequent escape of the wood-pecker, by suddenly diving into a hole its pursuers cannot enter, is quite pleasing and amusing to the observer. Its flesh has a strong flavor of ants, and is generally regarded as disagreeable; yet it is eaten by some sportsmen, and occasionally sold in the markets of Philadelphia and New York.

CAROLINA PARROT.

[PLATE XL.]

Psittacus carolinensis, LINNÆUS, WILSON, and AUDUBON.

DESCRIPTION.—Length, 13 inches; alar expanse, 21 inches; forehead and cheeks, orange-red; rest of head and neck, rich yellow; shoulder and bend of wing, edged with orange-red; above, bright-yellowish glossy-green, with bluish reflections, diluted with yellow below; interior webs of the primaries, dusky-purple; exterior ones, bluish-green; tail, long and graduated, exterior feathers, half length of middle ones; shafts of all the quills, black; knees and vent, orange; feet, pale-whitish flesh-color; claws, black; bill, white, slightly tinged with cream-color; iris, hazel. In the young, head and neck, wholly green, except front and cheeks, which are orange.

The Carolina parrot, or parakeet, is the only one of the two hundred species of its genus, which has been found in the United States. It is restricted to the warmer parts, rarely venturing north and east of Virginia, though it visits much higher latitudes in the West, being seen on the banks of the Illinois, occasionally on the southern shores of Lake Michigan, in the valley of the Juniata, in Pennsylvania, and, on an extraordinary occasion, at Albany, New York; but it is abundant in the regions of its residence, namely, South Carolina, Georgia, Florida, Alabama, Louisiana, and along the Mississippi up to Kentucky.

These parakeets are exceedingly annoying to the farmers, not only in consuming, but in laying waste and destroying his grain in stacks or standing in the field. They also lay waste orchards of pear and apple-trees, merely for the seeds, and this often before the fruit is ripe, when they consequently will not eat the seeds. They come in large numbers, and, though they appear to be concerned for the slaughter of their companions, they will not fly away from the deadly weapon which is destroying them; thus hundreds are often slain by the side of a single stack of grain, which they had covered so densely as to appear like a vast green carpet spread over it. But before commencing their depredations, they are shy and easily driven off; yet even then they will return to their own destruction rather than desert one of their companions which has been wounded or killed. The cockle-bur, so plentiful in the fields of the South and West, and for which, it is believed, no other use has been discovered, forms a staple article of food for these birds; but while it is commended by some for destroying the seeds of this weed, others believe that even this good is more than counter-balanced by the mischief it does in diffusing them throughout their haunts.

The roosting-places of this species are in hollow trees, and the holes excavated by the larger species of wood-peckers. At dusk, a

flock may be seen alighting against the trunk of a large sycamore or other tree having a considerable excavation within it. Alighting on the bark beneath the aperture, as many as can crawl into it do so, and the rest attach themselves by claw and bill to the exterior, and here repose throughout the night. The nests are in these cavities, several females depositing their eggs together. It is believed that each lays two, which are nearly round, and of a light greenish-white. Two years are passed before the young are in full plumage. The old ones are careful of their young, and are greatly excited upon the approach of any intruder toward their nests.

The flight of this bird is rapid and straight, through the forest or over rivers and fields, accompanied by inclinations of the body, which expose to view alternately the upper and under parts. They deviate from a direct course only when impediments occur, when they glide gracefully aside and continue on. They keep up a general cry when on the wing. They circle wide and high over a spot before alighting, and move with facility upon the trees, often in a sideling way; or hang in every imaginable posture. On the ground, they are awkward and helpless. If surprised, they do not attempt to escape; but when they see danger approaching, they hide, or scramble up the nearest trees they can find, by the aid of claws and bill, being great climbers, like the rest of the family to which they belong. When wounded, they try to bite, and are capable of inflicting considerable injuries. They are easily tamed, being subdued by repeated immersions in water. But, as they cannot be educated to utter words, as their screams are very discordant, and especially as they are exceedingly destructive, they ought not to be regarded as desirable pets. The flesh of the young is considered as tolerable food; but they have many insects upon them, and their skin is covered with a mealy substance detached from the roots of the feathers.

PASSENGER PIGEON.

[PLATE XLI.]

Columba migratoria, Linnæus, Wilson, and Audubon.

Description.—Length, 16 inches; alar extent, 24 inches; bluish-grey; belly, white; throat, breast, and sides, vinaceous; tail, black, of twelve feathers, the lateral ones, whitish; bill, black; iris, fiery-orange; legs and feet, lake-red; lower part and sides of neck with metallic changeable hue of gold, green and purplish-crimson, the last prevalent; scapular region, spotted with a few black blotches; quill-feathers, dusky. Female, shorter; changeable cervical spot, smaller and less brilliant.

The passenger pigeon, or wild pigeon, of America, ranges far to the north and south of the United States, and westward to the

Rocky Mountains; but is very rarely met with except in communities of millions or billions, requiring for their roosting-place an immense forest, the trees of which are soon crushed and blighted by their weight. This extraordinary gregariousness is wholly inexplicable.

The home, or roosting-place, of this pigeon is selected with reference to the abundance of beech and oak mast in the vicinity; that is to say, within a few hundred miles; for it is alleged of them that they fly at the rate of a mile a minute. Indeed, although they digest rice in twelve hours, food of this kind, which must have been procured in the fields of South Carolina or Georgia, has been found undigested in the stomachs of passenger pigeons killed in New York. They do not regard climate, except as it affects the supply of food; and only change their place of resort on this account, notwithstanding that men with nets and guns capture and destroy them, or rake their lodging-trees with poles, burn sulphur under them, cut down the trees, and by various other devices slaughter them by thousands. Sometimes they remain in a region of country for years, and are then absent from it as long, or until their new range evinces a scarcity and their former one becomes abundant. Wagons and vessels are often laden with them, when their roost is in an accessible locality, and hogs have been driven a hundred miles or more to such place to fatten on the heaps of the slain which each morning reveals.

In the evening, the air is sometimes darkened by these birds as by an eclipse of the sun; a rushing noise is heard, in the midst of which the sound of a gun cannot be distinguished; and the air is put in motion by the flutter of their wings. Hundreds upon hundreds of flocks now successively arrive, each one of countless numbers. Regardless of the slaughter committed upon them, they alight with flutterings upon the branches of the trees. Those which are killed at this hour and during the night are permitted to remain until the flocks have departed the next day; for the frequent falling of large limbs of trees renders it dangerous to venture beneath them. Wolves, foxes, lynxes, cougars, bears, raccoons, opossums, and skunks all then enjoy a feast, and are in turn followed by eagles, vultures and hawks. The hunters, meanwhile, after gathering all they want, turn their droves of hogs into the forest to partake of the repast.

As the supply of food alone determines the migrations, they do not occur at any particular season. The power of flight enables these birds to traverse and survey an astonishing extent of country in a very short time; their power of vision seems to be as great, enabling hem to perceive with certainty the resources of the country with respect to the food they seek. Thus, in passing over an inviting field, they at once descend near the earth, but as promptly ascend to take a more extended range, when a sterile region is beneath them.

Mr. Audubon once tried to count the number of flocks successively flying through the air above him in a single hour. In a short time, he had numbered one hundred and sixty-three, but found it impos-

sible to keep the count, and desisted. "The light of noon-day was obscured as by an eclipse," he says, "and the continued buzz of wings had a tendency to lull my senses to repose." They were passing for three days in succession, and their flight was higher than the best rifle could carry. When a hawk pressed upon a flock of them, like a torrent, and with a noise like thunder, they rushed into a compact mass, and, darting forward in undulating and angular lines, descended and swept close over the earth with inconceivable velocity, then mounted perpendicularly, so as to resemble a vast column. When high in the air again, they were seen wheeling and twisting within their concentrated lines, which then resembled the coils of a gigantic serpent. These movements are not confined to the flock assailed, the same evolutions being performed by all which follow, though the astonished hawk has long since fled from the field. On these occasions, when the backs of the birds come into view, a glistening sheet of azure is presented; and anon a mass of rich deep-purple. Compelled by hunger to alight, they scatter the fallen leaves of the forest in quest of mast, the rear passing over the front meanwhile like the waves of the sea, and the whole body appearing still to be on the wing. In a very brief time, thus they glean every atom of food upon a vast expanse of forest. After feeding, they rest upon the trees for a time, but toward sunset return to their roost, though it may be hundreds of miles off.

Their period of breeding is not influenced by season; the place is selected with reference to the contiguity of food and water. Forest trees of great height are chosen, and upon these a hundred nests are often built, frail structures composed of a few dry twigs crossing each other, and supported by forks of the branches. The common note of this bird is like the repeated syllable *ke, ke, ke*, but at this time it is a soft *coo, coo, coo, coo*, shorter than that of the domestic species. The proud bearing of the male now resembles that of the tame pigeon, and the caressing is the same. The eggs are two in number, of broadly elliptical form, and pure-white. During incubation, the male supplies the female with food. A male and female generally comprise the brood. The parents feed them by disgorging into their bills the contents of their crops. But the young soon leave the parent-nest to seek their own livelihood, and in six months are capable of reproducing their species. Dr. Bachman states that, in the more cultivated parts of the United States, they now often breed in isolated nests.

The flesh of the wild pigeon is of a dark color, and tolerable as food; while that of the squab is greatly esteemed.

RUFFED GROUSE.

[PLATE XLII.]

Tetrao umbellus, WILSON, BONAPARTE, AUDUBON, and NUTTALL.

DESCRIPTION.—Length, 18 inches; alar expanse, 24 inches; head, neck, and crest, black, and pale-chestnut in spots and bars; lower part of back and rump, dusky, feathers broadly terminated with chestnut and grey, mottled with dusky, roundish paler spot toward the ends of the feathers; black ruff, presenting violet reflections; coverts of wings, more mottled and rufous, a number of the tertials with oblong whitish-brown spots on the outer webs only; primaries, pale-dusky; inner webs, brownish-white, with darkish spots, fourth primary, longest, long axillary feathers, white, with grey bars; throat, pale-rufous, with dusky spots below the feathers, with pale-rufous and grey bars, and broad white tips; downy vent feathers, nearly white; lower tail-coverts, pale-rufous, inverse arrow-heads of white; flanks, mostly distinctly barred; feet and bill, pale livid-brown; iris, hazel; in many birds, tail almost wholly grey; male, ruff, broad black feathers on sides of neck; female, ruff, smaller, dusky-brown.

The mountainous regions of the Middle States are the usually preferred residence of the ruffed grouse, (called partridge in Connecticut and eastward, and pheasant southward and westward,) although it is known to extend over the whole breadth of the continent, northward as far as the fifty-sixth parallel, and southward to Texas, and probably still further. It is more abundant in the Western, Middle and Eastern than in the Southern States. In the maritime portions of South Carolina, indeed, Mr. Audubon says it does not exist.

There is a close resemblance between this bird and the domestic fowl, in their natural habits, especially with respect to the rearing of their young. About the 1st of May is the season for forming the nest, which the female constructs of dry leaves and herbaceous plants, in a spot where a heap of leaves has been formed by the wind, on the ground, beside a prostrate tree, or at the foot of a low bush. She lays from five to twelve eggs, of a dull-yellowish color. As she does not cover them on leaving her nest, like the turkey, goose, and duck, the crow and raven not unfrequently devour them. When she is present, she defends them with great obstinacy, striking the intruder with her wings and feet after the manner of the common hen. As soon as the young emerge from the shell, which is about three weeks after the hen has commenced sitting, they are able to follow their mother, sometimes, indeed, running with a portion of the shell adhering to them; and when but six or seven days old, they are capable of flying a few yards at a time. She then leads them abroad in quest of food, covers them with her wings, and in every way provides for and protects them. Her least chuck of alarm

causes them to squat, when she freely exposes herself for their sake, even feigning lameness, or tumbling or rolling about, as if wounded, to divert attention from them. Their instinctive regard for self-preservation is so strong as to induce the most perfect silence while an enemy is near. The practice of an almost promiscuous intercourse, on the part of the males, leaves them free from all share in these offices, and at this season, they are associated in small parties, and continue to do so until the approach of winter, when males and females, old and young, mingle together, only one brood being raised in the year. Fierce contests often arise between the jealous males, but the females evince no interest therein.

Although a permanent resident in the region it inhabits, the ruffed grouse performs partial sorties at the approach of autumn, but not so extensive as the peregrinations of the wild turkey, the little partridge, or the primated grouse, yet sufficiently so to be noticeable at periods when the food in some mountainous localities becomes scarce. This tendency is not sufficient to reduce their number perceptibly; but the lingering of numbers of them, for a week or two, in the early part of October, at a river's side, apparently timid about crossing, often apprizes their human enemies of their migratory purpose, and betrays them to his fatal love of sport. It is not known, however, that any of them ever perish by falling into the water in their migrations. Within a day or two after crossing a river, they retire to a congenial place in the forest to resume their usual habits. At the approach of spring, they retrace their journey, the males leading the way singly, and the females following in parties of three or four.

In the fall, the flesh of these birds is sweet, tender, and easily digested. In the winter, they bring 75 cents or $1 each, in the New York and Philadelphia markets; but, in their autumn migrations they become so plentiful, and are so easily slain, that they are often sold for 12½ cents each. It is said by some persons that their flesh is poisonous after they have eaten the leaves of the laurel, (*Kalmia latifolia,*) but Mr. Audubon appears to doubt this.

Although the ruffed grouse is partial to the craggy sides of mountains and hills, and the rocky borders of rivers and small streams, thickly mantled with evergreen, small trees, and shrubs, they at times remove to low-lands, and even enter the thickest cane-brakes, where they sometimes breed. In the spring and autumn, the male often betrays himself to the gunner by a drumming noise produced by his wings, which they have been known to continue for several hours at a time, and may sometimes be heard at a distance of half a mile. Their human persecutors imitate this noise, by tapping upon dry and inflated bladders, when the bird comes forth to combat a supposed rival, and is shot; and they are also caught in traps set upon their drumming-ground, or logs. Different species of hawks also destroy them, particularly the red-tailed and Cooper's hawks. Skunks, weasels, raccoons, opossums, and foxes are also their foes, some of them sucking their eggs, and others feeding on their flesh.

Seeds and berries of all kinds, and the leaves of the checker-berry, (*Gaultheria procumbens*,) and several other species of evergreens, when other food is scarce, chiefly comprise their food; but they are particularly fond of fox-grapes, winter grapes, strawberries, and dew-berries. In winter or early spring, they eat the tender buds of various trees, and thus sometimes prove injurious to the apple and other fruit-crops, located near dense woods. They are then easily approached, but are too lean to be desired. About the 1st of September, when the mountains are covered with whortleberries and blackberries, is the proper time for shooting and catching them. Trap-boxes are then used, as well as the "figure-of-four." When the snow is deep, they often conceal themselves by diving beneath it and emerging at a distant place, but are often caught in the attempt.

The whirring noise produced by these birds when rising in alarm from the ground is not made at any other time. Its usual flight is low, straight-forward, and seldom more than a few hundred yards at a time, being also stiff, and accompanied with a beating of the wings for more than half the distance, after which, it seems to sail like a ship before the wind. It moves gracefully and proudly upon the ground, until alarmed, when it lowers its head, expands its tail, first runs a little distance, and then flies away with a whirring noise. It may be shot by an expert sportsman when it first rises, but if any kind of a thicket is at hand, its subsequent retreat is under the protection thus afforded, by which it is screened from view. A noisy cur-dog is therefore often useful in alarming these birds again and causing them to ascend. When one of them gains the branch of a tree, it remains quietly perched in an upright position until the danger is over. It also roosts in such situations, and is frequently smoked from its retreat when discovered by man; or a dog, trained to "treeing" partridges, when he has scared one from the ground to a tree, will fix its attention upon himself until the gunner brings it to the ground.

SPOTTED OR CANADA GROUSE

[PLATE XLIII.]

Tetrao canadensis, Bonaparte, Audubon, and Nuttall.

Description.—Length, 15 inches; alar expanse, 21 inches; weight, 23 ounces; general colors, black and grey, mingled in transverse, wavy crescents; ground color of all feathers, black; upper tail-coverts, black-brown, mottled on margins with greyish-rusty, and broadly tipped with whitish-grey; breast, deep-black, feathers broadly terminated with white; under tail-coverts, deep-black, pure-white for half an inch at their tips; under wing-coverts and axillary feathers, brownish-dusky, some of largest, white shafts and terminal

spots; primaries, dusky, and without white spots; tail, 6 inches long, almost entirely black, usually with a broad rufous tip, sometimes probably worn off. Female, an inch shorter; plumage, more varied, less black and more ferruginous.

The spruce partridge or Canada grouse breeds in the States of Maine, New Hampshire, and Vermont about the middle of May nearly a month earlier than at Labrador. It is also plentiful in the mountainous districts of New Hampshire and the northern parts of New York, as well as around our great lakes and the head waters of the Missouri. It is abundant in the British provinces, New Brunswick, Nova Scotia, Newfoundland, and Labrador. It is partially migratory in winter.

The breeding-grounds in Maine, among the "hackmatack woods," (*Larix americana*,) are as difficult to traverse as the most tangled swamps of Labrador. The ground is covered with verdant moss over which the grouse walk, but into which their human foe sink deep at every step, while struggling through the trunks of dead trees and branches of greenwood, and low bushes. Proud, gallant, and assiduous to the females in early spring, as soon as incubation has commenced, the males repair to another forest and do not return to the females until late in autumn, when the young are reared. In this retreat, the males are very wary and shy. The nest, formed by the female, consists of a bed of twigs, dry leaves, and moss, on which she deposits from eight to fourteen eggs, of a dark-fawn color, irregularly spattered with different tints of brown. They raise only one brood in a season, and the young follow the mother as soon as hatched.

These birds walk much after the manner of our partridge, but are not so often found upon the ground. They do not jerk their tails nor burrow into the snow, as the ruffed grouse, but usually resort to the trees for safety, when pursued, whence they seldom remove; and when they do, it is but to a short distance.

All the species of this genus indicate the approach of rain or snow with wonderful precision. On the afternoon previous to such weather, they resort to their roosting-places very early; or on the same day, a few hours before the commencement of the storm. This forecast probably exists in the whole tribe of gallinaceous birds.

The food of the Canada grouse consists of berries of different kinds, and the young twigs and blossoms of several species of plants. In summer and autumn, they may be found gorged with the berries of the plant called "Solomon's seal," and, in the winter, the short leaves of the larch, or hackmatack, afford them food. They have thriven well upon oats, when in captivity.

The flesh of this bird is dark, and fit for eating only when berries are abundant, being bitter and disagreeable in winter, when the leaves of plants and trees are eaten by them.

GREAT RED-BREASTED RAIL.

[PLATE XLIV.]

Rallus elegans, AUDUBON.

DESCRIPTION.—Length, 19 inches; alar expanse, 25 inches; bill, longer than head, compressed, slightly curved, deep at base; head, small, oblong, compressed; neck, long, slender; body, slender, compressed; feet, long; tibia, bare far above joint; tarsus, long, sides, reticulated; plumage, rather stiff, compact, glossed on upper parts; iris, bright-red; feet, yellowish-brown, tinged with olive; claws, same color; upper part of head and neck, dull-brown; bristle-like shafts of frontal feathers, black; brownish-orange line from bill over eye; broader band of same color from lower mandible; intermediate space, dusky; chin, white; upper parts, in general, streaked with brownish-black and light olive-brown, sides of each feather of latter color; wing-coverts, dull-chestnut, most of them irregularly tipped with brownish-white; alula and primaries, deep olive-brown; secondaries and tail-feathers, like the back; sides and fore-part of neck and greater part of breast, light orange-brown; sides and lower wing-coverts, undulated with deep-brown and greyish-white; tibial feathers, pale greyish-brown, faintly barred with darker, as is the hind-part of the abdomen, the fore-part, pale greyish-brown; lateral lower tail-coverts, white, each with a blackish-brown spot near the end; those in the middle, barred with black and white.

The Rallus elegans, of Audubon, has been confounded with the R. crepitans, by other authors. The former, now under notice, is altogether a fresh-water bird, and breeds and lives throughout the year far inland, in the Southern States, only a few stragglers having been observed east of Pennsylvania; while the latter never removes from the salt-marshes on the Atlantic, from New Jersey to the Mexican Gulf.

This bird resides in the fresh-water marshes and ponds in the interior of South Carolina, Georgia, Florida, and Louisiana, whence a few migrate, and probably breed, as far to the eastward as the wet meadows of the Delaware and Schuylkill rivers. In the extensive marshes of the Southern States, contiguous to sluggish streams, they may be seen gliding swiftly among the tangled rank grasses and aquatic weeds, or standing on the broad leaves of the yellow cyamus and fragrant water-lily, or forcing their way through the dense foliage of pickerel weed (pontederiæ) and arrow-head (sagittariæ.) Twenty pairs have been found breeding within an area of 30 yards' diameter in such places. The nests are built upon the ground, shallow at first, but, as the nine or ten eggs are successively deposited, their walls are elevated to the height of 6 or 8 inches by means of withered weeds and grass. The middle of April is usually the beginning of the breeding-season, though some of them commence even a month earlier. They return to the same nests in successive years, and often repair or improve them. The young, which are at first black, leave

the nest as soon as they burst the shell, and follow their mothers along the borders of the streams and pools, where they find abundance of grass-seeds, insects, tadpoles, leeches, and small craw-fish. At this season, they may be easily mistaken for meadow-mice.

The food of the adult rail is varied, consisting not only of the articles already named, but of the wild cane, (*Arundo tecta,*) common oats, &c. They are rarely shot by ordinary gunners, because of the difficulty of raising them, and because they generally confine themselves to places so swampy and covered with briers, smilaxes, and rough weeds that they are scarcely accessible. Although they are comparatively safe from man, they are not without other enemies. The moccasin snake is known to destroy them, as is also the mink, the barred owl, the great horned owl, and the wild-cat.

In seasons of extreme drought, these birds wholly disappear from their accustomed haunts, and doubtless resort to the shores of larger and deeper ponds until after a heavy fall of rain. The young acquire the redness of their plumage the first summer, and increase in size and beauty for several years, without experiencing any change in their coloring after the spring following that of their birth. The sexes differ in appearance only with respect to size, the males being considerably larger than the females. It is believed that this species raise but one brood a year; although the eggs may be replaced when destroyed during the period of incubation. Their flight is stronger and more protracted than that of the salt-water species. When flushed, they rise and go off with a chuck, their legs dangling beneath them; and, alighting in the grass at a considerable distance, they run off with surprising speed. Indeed, they depend for safety even more upon their fleetness and adroitness on foot than on the wing. They are less apt to take to the water than the Rallus crepitans, and are by no means so expert at diving. Their flesh is very good, especially in autumn, when they feed on grass-seeds. Their size, as well as their flavor, renders them desirable to the sportsman and epicure. Their eggs are also excellent, being preferable to those of the common fowl. Their number does not appear to diminish in winter by migration.

WHOOPING CRANE.

[PLATE XLV.]

Ardea americana, WILSON.
Grus americana, BONAPARTE and AUDUBON.

DESCRIPTION.—Length, from tip of bill to end of claws, 5 feet, 5 inches; to end of tail, 4 feet, 6 inches; alar expanse, 7 feet, 8 inches; length of wing, 22 inches; weight, nearly 10 pounds; bill, wax-yellow, 6 inches long, $1\frac{1}{2}$ thick; iris, yellow; forehead, whole crown and cheeks, covered with dull orange-colored warty skin, thinly interspersed with black hairs; hind-head, ash-color; rest of plumage, pure-white, except primaries, which are brownish-

black; from base of each wing arise numerous large, flowing feathers projecting over tail and tips of wings, some closely webbed like feathers of ostrich; legs and naked parts of thighs, black; hind-toe, articulated too high to reach the ground. Young, tawny.

The whooping crane, or sand-hill crane, breeds from upper California northward to the Arctic regions, whence it removes southward early in autumn, and soon arrives in the regions of the United States, from North Carolina to Texas, and thence westward to the Rocky Mountains, and remains throughout the winter. In the Middle States, east of the Alleghanies, it is very rarely seen, and thence eastward to Maine it is unknown, all its migrations being performed far inland. While migrating, it travels both by day and night, and in total disregard of the character of the weather, its power of flight enabling it to resist the force of heavy gales. Thirty or forty form a flock, which is sometimes arranged in an acute-angled triangle, sometimes in a long line, and at others with an extended front, and sometimes flying in apparent disorder, each bird sounding his loud note in succession, as upon all occasions of alarm.

The middle of October or beginning of November is the period of the arrival of this species in the United States, and the end of April, or beginning of May, of its departure for the North. They here frequent the edges of large ponds supplied with rank herbage, on fields or savannas, now in swampy woods, and again on extensive marshes. The interior of the country and the neighborhood of seashores suit them equally well, so long as the temperature is sufficiently high. Both the old and the young may be seen digging through the mud before the rains have begun to cover the shallow ponds. They work assiduously with their bills, and succeed in uncovering the large roots of the great water-lily, which often run to a depth of 2 or 3 feet. Several cranes operate at the same root, and devour it together when obtained. They may then be approached easily, and a number killed at a single shot. When this description of food fails, they resort to the fields to devour corn, peas, sweet potatoes, and cotton seeds, and in the wet fields, seize on water insects, toads, and frogs, and occasionally a mole, a meadow-mouse, or a snake, but not upon fish, as is believed. They feed only during the day.

Though these birds may be easily killed while intent upon exhuming their food, their senses of sight and hearing are so acute, and their wariness is so great, that it requires the practice of much adroitness to approach them. They are on the alert the moment a man appears, though a fourth of a mile distant; and, if not seen, the snapping of a twig beneath his feet, or the closing of a gate behind him, is sufficient to challenge their vigilance. They observe his motions with unerring precision. Mr. Audubon says he would as soon undertake to catch a deer by fair running as to shoot one of these cranes which had observed him. When wounded, they are capable of inflicting severe injuries upon an unwary sportsman. Wilson states that one of them has even been known to drive his bill through a man's hand at such a time. The young are more numerous than

the old. They are killed both for their flesh, which many relish, and for their beautiful long feathers, of which fans and fly-brushes are sometimes made.

In some regions, these birds leave their feeding-ground an hour before sunset, and silently repair to the interior of a highland forest, where six or seven of them alight on the branches of a lofty tree to roost. Here, after dressing their feathers for half an hour, they crouch in the manner of wild turkeys, and, when there is moonlight, may then be shot. In other regions, they roost in the midst of tall grass, cat-tails, and other plants, near the marshes, selecting a dry hillock upon which they stand on one foot, the other being drawn under the body, while the head is thrust beneath the broad feathers of the shoulder. In captivity, they become gentle, and feed on grain and other vegetables, though they are occasionally mischievous, and wantonly pick and maim chickens and other poultry. They probably do not attain their full size nor perfect plumage before they are four or five years old.

WILSON'S SNIPE.

[PLATE XLVI.]

Scolopax wilsonii, Bonaparte and Audubon.
Scolopax gallinago, Wilson.

Description.—Length, 11 inches; alar expanse, 17 inches; bill, 2½ inches; crown, black, divided by pale-brown line, same over each eye; dark-brown stripe on lores, and obliquely beneath ears; neck and upper part of breast, pale-brown, with small dusky longitudinal spots; back and scapulars, deep-black, bronzy reflections, latter faintly barred, broadly edged exteriorly with pale-brown and white; central feathers of the back, broadly edged on their outer margins with dilute-brown, producing broad, pale stripes down centre of back; same feathers, minutely tipped with brown; wings, plain dusky; outer web of first primary and lower portion of shaft, white; outer spurious feather of bastard wing, acuminated, and white except dusky space along shaft; wing-coverts, dusky, tipped with white, upper ones, paler and broadly edged with a tint of brownish-white, shoulder of wing, dusky-brown and glossy; tail-coverts, long and dusky, faintly barred with pale-brown; tail, rounded, black, with a bright-ferruginous zig-zag, subterminal, broad band, then crossed by a similar narrower, dusky bar, and tipped with dilute-brown, passing externally into white; on some of the lower feathers, there is either a ferruginous spot below the larger bar on the inner web, or a pale, greyish-ferruginous entire bar; the outermost narrow feather is almost wholly white, tinged with dusky on inner web, and crossed by five dark bands; belly, white, sides barred broadly with dusky, but faintly tinted, like breast, with dilute-brown; throat and commencement of breast, faint greyish-brown, with broad and darker indistinct stripes along the sides of the throat; long axillary feathers, pure-white, with eleven or twelve broad and very elegant angular dusky bands on the longest of them; the lining of the wing, white, and also barred with the

same. Vent, pale-brown; sides, tawny, with dusky spots and bars; legs and feet, cinereous-olive. Young, throat and neck almost equally mottled, tertiaries and lesser wing-coverts more abundantly barred with pale-brown, edged and tipped with white; white edgings on scapulars, and back feathers also more conspicuous; rump and tail-coverts, lighter; ferruginous bands on tail, more intense; bill, one-fourth of an inch shorter.

The summer range of Wilson's snipe, or the common American snipe, extends northward far beyond the limits of the United States. In the mountains of the Carolinas, at all times, they may breed; but it is thought that this only occurs in the cases of individuals disabled for flight. In Virginia and Maryland, they sometimes breed, and in Pennsylvania rather more frequently. In Maine, they are abundant in the breeding-season, but are still more plentiful in Nova Scotia, where they lay their eggs early in June. The swampy parts of the extensive moss-covered marshes, in elevated situations, afford them places of security and comfort. Their nests are mere hollows in the moss, scantily inlaid with grass. The eggs, which are three or four in number, and placed with the small ends together, measure $1\frac{5}{8}$ by $1\frac{1}{8}$ inches, are pyriform, with the tips somewhat inflated; ground color, yellowish-olive, pretty thickly spotted and blotched with light and dark-umber, the markings increasing in size as they approach the large end, where they form a circle. The young leave the nest as soon as hatched, when they are covered with down of different tints of brown and greyish-yellow, and seem at first to feed on minute insects, but soon, like their parents, probe the ground in the oozy mire for worms, roots of vegetables, &c. When they breed in the Middle States, the meadow is apt to be chosen by them, though they also nestle in mountain districts.

In the Western country, this snipe arrives from the North early in October, and resorts to meadows watered by warm springs, and the borders of ponds and small secluded rivulets, or to the corn-fields, after a protracted rain, but never to the woods, nor to any place from which they cannot easily escape when approached. In Kentucky, they often remain in large numbers all winter, but are more plentiful further south, especially in Louisiana, where they are named *cache-cache*, by the Creoles. In the latter State, they are often met in flocks of 50 or 100, as well as in South Carolina, where they delight to resort to the rice-fields, but are there shot in large numbers. So determined are they in their preference for a particular locality that the noise and destruction produced by the gunner do not cause them to leave it, but simply to rise into the air, cry *wau-aik*, and soon fly back to the spot. When flying to a distance, they ascend very high, and, by regular and quickly repeated beats of the wings, proceed in a somewhat devious course; yet they travel a great distance in a very short time. Although they perform their migrations singly, or in small parties of a single family, there is yet a continuous plan, since a region of country is soon filled with them. When surprised by the sportsmen or other enemy, they rise at a spring, take a zig-zag course, emit their cry, and at a distance of 60

or 70 yards ascend into the air; but sometimes they squat with great pertinacity. When they alight on a chosen spot, they examine the place very warily before probing the ground in quest of food, ground-worms, or the juicy and slender roots of different vegetables. Mr. Audubon states that many epicures eat snipe and wood-cock with all their viscera, regarding the intestines as the most savory parts, though worms, leeches, and insects have been the food of the birds.

Returning to the North, in autumn, they arrive in Pennsylvania about the middle of March, a month later in Maine, and eight or ten days later in Newfoundland or Labrador. They often mate before going southward in spring. It is believed by some that the male assists in incubation; but this is not certain. During the period of incubation, the male produces a few pleasing rolling notes when sporting in the air, and even while attending his mate upon her nest at night. The young acquire their full plumage during the first year of their existence. There is then no difference in the appearance of the male and female, except the superior size of the latter.

IMPROVEMENT OF LAND.

DRAINAGE.

BY HENRY F. FRENCH, OF EXETER, NEW HAMPSHIRE.

The next great improvement in the agriculture of our country, which will be generally adopted from the practice of the Old World, is "Drainage." In almost every State, extensive tracts of swamp-lands are found, not only unfit for cultivation, but, in many instances, by reason of noxious effluvia arising from stagnant water, they are prejudicial to health. Large grants of these lands have been made by Congress, from the public domain, gratuitously, to the States in which they lie, upon the idea that they were not only worthless to the government, but dangerous to the health of the neighboring inhabitants, with the hope that the State governments might take measures to reclaim them for cultivation, or, at least, render them harmless, by the removal of their surplus water.

It is ascertained, by inquiry at the Land Office, that more than 52,000,000 acres of swamp and overflowed lands have been selected under the Acts of March 2d, 1849, and September 28th, 1850, from the dates of those grants to September, 1856; and it is estimated that, when the grants shall have been entirely adjusted, they will amount to 60,000,000 acres.

Governor Wright, of Indiana, in a public address, estimated the marshy lands of that State at 3,000,000 acres. "These lands," he says, "were generally avoided by early settlers, as being compara-

tively worthless; but, when drained, they become eminently fertile." He further says: "I know a farm of 160 acres, which was sold five years ago for $500, that by an expenditure of less than $200, in draining and ditching, has been so improved, that the owner has refused for it an offer of $3,000."

At the meeting of the United States Agricultural Society, at Washington, in January, 1857, Mr. G. W. P. Custis spoke, in connection with the great importance of this subject, of the vast quantities of soil—the richest conceivable—now lying waste, to the extent of 100,000 acres, along the banks of the Lower Potomac, and which he denominates by the old Virginia title of *pocoson*. The fertility of this reclaimable swamp he reports to be astonishing; and he has corroborated the opinion by experiments which confounded every beholder. "These lands on our time-honored river," he says, "if brought into use, would supply provisions at half the present cost, and would in other respects prove of the greatest advantage."

In the Southern States, we have extensive tracts of swamps, inaccessible to all but alligators, Indians, and fugitives, which render at certain seasons the very air of heaven pestilential. In the New England States, also, in every county, there is a considerable proportion of bogs and wet meadows, among our almost barren hills, into which the uplands have for centuries poured treasures of fertilizing elements, but which are given over to desolation, by reason of too much cold water.

Again, all along our Atlantic coast, and far up the navigable rivers, are vast tracts of salt-marshes, or flat-lands, abounding in fertility, overflowed, some of them regularly, and others occasionally, by the ocean tides. These marshes, with some cost of ditching, produce what is called "salt-hay," which is cut with great labor at low tides, and generally stacked where it grows, upon stakes driven for the purpose. It is valued and usually sold at about half the price of the best upland meadow-hay, and mixed with other fodder, is eaten by cattle which can get nothing better, and sometimes by way of a condiment even by cattle that are well fed. It has been doubted by many, whether this salt-hay is worth the cost of cutting, or, in other words, whether the labor requisite to ditch the marshes, and cut, cure and haul the hay, could not be more profitably applied to other branches of farm labor. By many experiments, on a small scale, in this country, it has been proved that these salt-marsh lands, after the tides have been kept out of them a few years, are extremely fertile, and, being free from stones and other obstructions, are easily cultivated, and so are likely, when a systematic mode of reclaiming them shall be adopted, to prove a most valuable acquisition to our farmers upon the ocean shores.

Along our rivers and streams, in every part of the country, are large tracts of low, flat-lands, flooded in times of freshets, and at all times filled with cold or stagnant water, and are nearly or quite unproductive. In New England, on almost all the streams, and at the outlets of the lakes and ponds, are dams, for the use of saw-

mills, grist-mills, and factories, and the interior lakes are used as reservoirs to keep back water for the use of the mills in time of drought. By these obstructions to the natural flow of the streams, thousands of acres of the most valuable lands in this section are rendered worse than useless; for the water is kept up till midsummer, and drawn off when a dog-day climate is just ready to convert the rich and slimy sediment of the pond into pestilential vapors. This same evil has attracted attention in Scotland. "In many parts of this country," says a Scottish writer, "small lochs (lakes) and dams are kept up for the sake of mills under old tenures, which, if drained, the land gained by that operation, would, in many instances, be worth ten times the rent of such mills."

These swamps, ponds, and stagnant meadows might all be drained, and afford vast tracts of easy and fertile lands, equal to the bottom-lands of the West; and they are right by the doors of young men who leave their homes with regret, because the rich land of far-off new States offers temptations which their native soil cannot present. Now, while we should never advocate any attack upon the rights of mill-owners, or ask them to sacrifice their interest to those of agriculture, it surely is proper to call attention to the injury which the productive capacity of the soil is suffering, by the flooding of our best tracts, in sections of the country where land is most valuable. Could not the mill-owners, in many instances, adopt steam instead of water power, and, becoming land-*draining* companies, instead of land-*drowning* companies, at least let Nature have free course with her gently-flowing rivers, and allow the promise to be fulfilled, that the earth shall be no more cursed with a flood?

For the reclaiming of salt-marshes and of flats upon our rivers, as well as for the draining of lakes and ponds, a thorough knowledge of the proper methods of constructing embankments is requisite. This belongs, however, to a branch of the science of engineering, above the practice of the common agriculturist, and beyond the scope of the design of this article.

To show the practicability of conducting operations of draining, not only of marshes, but even of extensive lakes, in such manner as to repay by the land reclaimed, the expenses of the process, no better illustration is required than the draining of Haarlem Lake, an account of which is given at large in the Agricultural Report of the Patent Office for 1855. An outline of the operation is well worth inserting in this connection:

This lake was situated in North Holland, and covered 40,000 acres, being 33 miles in circumference. Its bottom was more than 13 feet below the lowest tide of the bay into which it emptied. Such it was in 1839. Now, no lake is to be found; but in its place, in October, 1855, "what had been the bed of a great lake, was then a region of exceedingly fertile land, in a fine state of cultivation. It was dry, comfortable and healthy. Numerous neat, quaint and conveniently-constructed cottages were seen in various directions; a population of about two thousand dwelt within the *polder*, or tract

below the level of the sea, fields of verdure extended far and wide, enlivened by cattle, horses and sheep, grazing on the fruitful meadows."

Think of such a scene in the bottom of a lake, and a lake not in a well-defined basin of solid rock or earth, but surrounded, in great part, by wet and marshy lands, so soft and spongy that portions of it rose and fell with the tide! The leading object of reclaiming this tract was not so much to subserve the purposes of agriculture, as to prevent the dangers of inundation, the waters of the lake having once been driven by the wind over its banks to the serious injury of the city of Amsterdam, some miles northeasterly of it; and at another time, in the same year, 1836, the city of Leyden, on the opposite side, having suffered a like calamity.

The work was performed by the government at the expense of about $80 an acre. A canal of some 140 feet width, 9½ feet deep, and 40 miles in length was cut around the lake, a dyke was formed between the lake and the canal, and when all was ready, the water of the lake was all pumped out by steam-engines, which are still kept in readiness to remove the rain or melted snows, or any surplus water that may, by leakage or breaking away of the works, endanger the security of the inhabitants, or injuriously affect the fertility of the soil. It is estimated that the land thus rescued from the dominion of the sea, is of twice the average value for cultivation of that of Holland generally, there being no waste land in the tract except the canals or drains. Upon this estimate, it is capable of supporting 70,000 persons, or double the present average population per acre of the two Provinces of Holland. Important as the considerations alluded to are, as to the drainage of lakes and marshes, and overflowed lands, there is another department of the same science of land-drainage, which, just at this time, has a higher practical importance to our agricultural interest, namely,

THE DRAINAGE OF HIGH-LANDS.

By ' high-land" is meant that, the surface of which is not overflowed, as distinguished from swamps, marshes, and the like lowlands. How great a proportion of such land would be benefitted by draining it is impossible to estimate.

The Committee on Draining, in their Report to the State Agricultural Society of New York, in 1848, assert that, "There is not one farm out of every seventy-five in this State, but needs draining—yes, much draining—to bring it into high cultivation. Nay, we may venture to say that every wheat-field would produce a larger and finer crop if properly drained." The committee further say: "It will be conceded, that no farmer ever raised a good crop of grain on wet ground, or on a field where pools of water become masses of ice in the winter. In such cases, the grain plants are generally frozen out and perish; or, if any survive, they never arrive at maturity nor

produce a well-developed seed. In fact, every observing farmer knows that stagnant water, whether on the surface of his soil or within reach of the roots of his plants, always does them injury."

The late Mr. Delafield, one of the most distinguished agriculturists of New York, said in a public address: "We all well know that wheat and other grains, as well as grasses, are never fully developed, and never produce good seed, when the roots are soaked in moisture. No man ever raised good wheat from a wet or moist subsoil. Now, the farms of this country, though at times during the summer they appear dry and crack open on the surface, are not in fact dry farms, for reasons already named. On the contrary, for nine months out of twelve, they are moist or wet; and we need no better evidence of the fact than the annual freezing out of the plants, and consequent poverty of many crops."

If we listen to the answers of farmers, when asked as to the success of their labors, we shall be surprised, perhaps, to observe how much of their want of success is attributed to *accidents*, and how uniformly these accidents result from causes, which thorough draining would remove. The wheat-crop of one would have been abundant, had it not been badly frozen out in the fall; while another has lost nearly the whole of his, by a season too wet for his land. A farmer at the West has planted his corn early, and late rains have rotted the seed in the ground; while one at the East has been compelled, by the same rains, to wait so long before planting, that the season has been too short. Another has worked his *clayey* farm so wet, because he had not time to wait for it to dry, that it could not be properly tilled. And so their crops have wholly or partially failed, and all because of too much cold water in the soil. It would seem, by the remarks of those who till the earth, as if there were never a season just right, as if Providence had bidden us labor for bread, and yet sent down the rains of heaven so plentifully as always to blight our harvests. It is rare that we do not have a most remarkable season, with respect to moisture, especially. It is always too wet, or too dry. Our potatoes are rotted by the summer showers, or cut off by a summer drought; and when, as in the season of 1856, in New England, they are neither seriously diseased, nor dried up, we find at harvest-time that the promise has belied the fulfillment; that, after all the fine show above ground, the season has been too wet and the crop is light. We frequently hear complaint that the season was too *cold* for Indian corn, and that the ears did not fill; or that a sharp drought, following a wet spring, has cut short the crop. We hear no man say, that he lacked skill to cultivate his crop. Seldom does a farmer attribute his failure to the poverty of his soil. He has planted and cultivated in such a way that, in a *favorable season*, he would have reaped a fair reward for his toil; but the season has been too wet or too dry; and, with full faith, that farming will pay in the long run, he resolves to plant the same land in the same manner, hoping in future for better luck.

Too much cold water is at the bottom of most of these complaints of unpropitious seasons, as well as of most of our soils; and it is in our power to remove the cause of these complaints and of our want of success.

> "The fault, dear Brutus, is not in our stars,
> But in ourselves."

We must underdrain all the land we cultivate, that Nature has not already underdrained, and we shall cease complaints of the seasons. We shall seldom have a season, upon properly-drained land, that is too wet, or too cold, or even too dry; for thorough draining is almost as sure a remedy for a drought as for a flood.

Do lands need underdraining in America? It is a common error to suppose that, because the sun shines more brightly upon this country than upon England, and because almost every summer brings such a drought here as is unknown there, her system of thorough drainage can have no place in agriculture on this side of the Atlantic. It is true that we have a clearer sky and a drier climate than are experienced in England, but it is also true that, although we have a far less number of showers and of rainy days, we have a greater quantity of rain in the year.

The necessity of drainage, however, does not depend so much upon the quantity of water which falls or flows upon land, nor upon the power of the sun to carry it off by evaporation, as upon *the character of the subsoil.* The vast quantity of water which Nature pours upon every acre of soil annually, were it all to be removed by evaporation, alone, would render the whole country barren; but Nature herself has kindly done the work of draining upon a large proportion of our land, so that only a healthful proportion of the water which falls on the earth passes off at the surface, by the influence of the sun.

If the subsoil is of sand or gravel, or of other porous earth, that portion of the water not evaporated passes off below by natural drainage. If the subsoil be of clay, rock, or other impervious substances, the downward course of the water is checked, and it remains stagnant, or bursts out upon the surface in the form of springs.

As the primary object of drainage is to remove surplus water, it may be well to consider with some care

THE SOURCES OF MOISTURE.

The water which falls in the form of rain and snow upon the soil of the whole territory of the United States, east of the Rocky Mountains, each year, is sufficient to cover it to the depth of about 3 feet. It comes upon the earth, not daily, in gentle dews, to water the

plants, but at long, unequal intervals, often in storms, tempests, and showers, pouring out, sometimes, in a single day, more than usually falls in a whole month.

What becomes of all this moisture is an inquiry especially interesting to the agriculturist, upon whose fruitful fields this flood of water annually descends, and whose labor in seed-time would be destroyed by a single summer shower, were not Nature more thoughtful than he, of his welfare. Of the water which thus falls upon cultivated fields, a part runs away into the streams, either upon the surface, or by percolation through the soil; a part is taken up into the air by evaporation, while a very small proportion enters into the constitution of vegetation. The proportion which passes off by percolation varies according to the nature of the soil in the locality where it falls.

Usually, we find the crust of the earth in our cultivated fields, in strata, or layers—first, a surface soil of a few inches of a loamy nature, in which clay or sand predominates; and then it may be, a layer of sand or gravel, freely admitting the passage of water; and perhaps next, and within 2 or 3 feet of the surface, a stratum of clay, or of sand or gravel cemented with some oxyd of iron through which water passes very slowly, or not at all. These strata are sometimes regular, extending at an equal depth over large tracts, and having a uniform dip, or inclination. Oftener, however, in hilly regions especially, they are quite irregular, the impervious stratum frequently having depressions of greater or less extent, and holding water like a bowl. Not unfrequently, as we cut a ditch upon a declivity, we find that the dip of the strata below has no correspondence with the visible surface of the field, but that the different strata lie nearly level, or are much broken, while the surface has a regular inclination.

Underlying all soils, at greater or less depth, is found some bed of rock, or clay, impervious to water, usually at but few feet below the surface, the descending water meeting with obstacles to its regular descent. The tendency of the rain-water, which falls upon the earth, is to sink directly downward by gravitation. Turned aside, however, by the many obstacles referred to, it often passes obliquely, or almost horizontally, through the soil. The drop which falls upon the hill-top sinks, perhaps, a few inches, meets with a bed of clay, glides along upon it for many days, and is at last borne out to be drunk up by the sun on some far-off slope; another, falling upon the sand plain, sinks at once to the "water-line," or line of level water, which rests on clay beneath, and, slowly creeping along, helps form a swamp, or bog, in the valley.

Sometimes, the rain which falls upon the high-land is collected together by fissures in the rocks, or by seams or ruptures in the impervious strata below the surface, and finds vent in a gushing spring on the hill-side.

At other times, in an undulating country, large tracts may rest immediately upon some highly porous stratum, as from B to C in the the following diagram, rendering the necessity of draining less

apparent, while the country, from A to B and from C to D may be full of springs and marshes arising partly from the rain itself, which falls in the latter districts, being unable to find a way of escape, and partly from the natural drainage of the more porous adjoining land being discharged upon it.

We see, then, that, although the rain is indeed the primary cause of all the superabundant moisture, against which we contend in draining, yet it is not only the quantity of rain that falls upon our own fields that must be regarded, but the probable influx of water, below, as well as above, the surface, must receive careful attention. A clear perception of how the excess of moisture is produced at the particular field of our operation is essential, in order to apply the remedy.

ADVANTAGES OF THOROUGH DRAINAGE.

The benefits which high-lands, as we ordinarily call them, in distinction from swamp or flowed lands, derive from drainage, may be arranged in two classes, *mechanical* and *chemical;* though it is not easy, nor indeed is it important, to maintain this distinction, in all points. Among those which partake rather of the nature of mechanical changes are the following:—

Thorough drainage deepens the soil. Every one who has attempted to raise deep-rooted vegetables upon half-drained swamp-land has observed the utter impossibility of inducing them to extend downward their usual length. Parsnips and carrots, on such land, frequently grow large at the top, but divide into numerous small fibres just below the surface, and spread in all directions. No root, except those of aquatic plants, will grow in stagnant water. If, therefore, it is of any advantage to have a deep, rather than a shallow soil, it is manifestly necessary, from this consideration, alone, to lower the line of standing water, at least to the extent to which the roots of our cultivated crops descend. A deep soil is better than a shallow one, because it furnishes a more extensive feeding-ground for the roots. The elements of nutrition, which the plant finds in the soil, are not all upon the surface. Many of them are washed down by the rains into the subsoil, and some are found in the decomposing rocks themselves. These, the plants, by a sort of instinct, search

out and find, as well in the depths of the earth as at its surface, if no obstacle opposes. By striking deep roots, again, the plants stand more firmly in the earth, so that they are not so readily drawn out or shaken by the winds. Indeed, every one knows that a soil two feet deep is better than one a foot deep; and market-gardeners and nurserymen show by their practice that they know, if others do not, that a trenched soil three feet deep is better than one of any less depth. We all know that Indian corn, in a dry soil, sends down its rootlets two feet or more, as well as most of the grasses. Cobbett says: "The lucerne will send its roots thirty feet into a dry bottom!" The Chinese yam, recently introduced, grows downward two or three feet. The digging of an acre of such a crop, by the way, on New England soil, generally, would require a corps of sappers and miners, especially when we consider that the yam grows largest end downward. However, the yam will no doubt prove a valuable acquisition to the country. Evidently it can grow to perfection only on a deep, well-drained soil, such as naturally exists in but a small portion of this or any other country. It is probable that most cultivated plants extend, in suitable soil, as deep as the yam; but the edible portion of this plant, unlike many others, seems to be that which is deepest in the soil, and so the utility of deep tillage is more obvious, to a casual observer, for this, than for other crops.

Thorough drainage allows pulverization. It was Tull's theory that, by the comminution, or minute division, of soils, alone, without the application of any manures, their fertility might be permanently maintained; and he so far supported this theory as, by repeated ploughings, to produce twelve successive crops of wheat on the same land without manure. The theory has received support from the known fact, that most soils are benefitted by summer fallowing. The experiments, instituted for the purpose of establishing this theory, although they disproved it, showed the great value of thorough pulverization. It is manifest that a wet soil can never be pulverized. Ploughing clayey or even loamy soils, tends rather to press it together, and render it less pervious to air and water.

The first effect of underdraining is to dry the surface soil, to draw out all the water that will run out of it, so that, in early spring or in autumn, it may be worked with the plough, as advantageously as undrained lands in midsummer.

Thorough drainage prevents surface-washing. All land, which is not level and is not in grass, is liable to great loss by heavy rains in spring and autumn. If the land is already filled with water, or has not sufficient drainage, the rain cannot pass directly downward, but runs away upon the surface, carrying with it much of the soil, and washing out much what remains of the valuable elements of fertility which have been applied with such expense. If the land be properly drained, the water falling from the clouds is at once absorbed, and passes downwards, saturating the soil in its descent, carrying the soluble substances with it to the roots; and the surplus

water runs away in the artificial channels provided by the draining process. So great is the absorbent power of drained land that, after a protracted drought, all the water of a heavy rain-storm will be drunk up and held by the soil, so that, for a day or two, none will find its way to the drains, nor will it run upon the surface.

Thorough drainage lengthens the season for labor and vegetation. In the colder latitudes of our country, where a long winter is succeeded by a torrid summer, with very little ceremony by way of an intervening spring, farmers have need of all their energy to get their seed seasonably into the ground. Snow often covers the fields in New England into April, and the ground is so saturated with water that the land designed for corn and potatoes frequently cannot be ploughed till late in May. The manure is to be hauled from the cellar or yard, over land lifted and softened by frost, and all the processes of preparing and planting are necessarily hurried and imperfect. In the Annual Report of the Secretary of the Board of Agriculture, of the State of Maine, for 1856, a good illustration of this idea is given: "Mr. B. F. Nourse, of Orrington, ploughed and planted with corn a piece of his drained and subsoiled land, in a drizzling rain, after a storm of two days. The corn came up and grew well; yet this was a clayey loam, formerly as wet as the adjoining grass-field, upon which oxen and carts could not pass, on the day of this planting, without cutting through the turf and miring deeply. The nearest neighbor said, if he had planted that day, it must have been from a raft." Probably two weeks would be gained in New England, in spring, in which to prepare for planting, by thorough drainage, again, which no one can appreciate but a New England man, who has been obliged often to plough his land when too wet, to cut it up and overwork his team, in hauling on his manure over soft ground, and finally to plant as late as the 6th of June or leave his manure to waste, and to lose the use of his field till another season; and all because of a surplus of cold water.

Mr. Yeomans, of New York, in a published statement of his experience in draining, says that, on his drained lands, "the ground becomes almost as dry in two or three days after the frost comes out in spring, or after a heavy rain, as it would do in as many weeks before draining." But the gain of time for labor is not all. We gain time also for vegetation by thorough drainage. Ten days, frequently, in New England, may be the security of our corn-crop against frost. In less than that time, a whole field passes from the milky stage, when a slight frost would ruin it, to the glazed stage, when it is safe from cold; and twice ten days of warm season are added by this removal of surplus water.

Thorough drainage prevents freezing out. Mr. John Johnston, of Seneca county, New York, in 1851, had already made 16 miles of tile drains. He had been experimenting with tiles from 1835, and had, on four acres of his drained clayey land, raised the largest crop of Indian corn ever produced in that county—83 bushels of shelled

corn to the acre. He states that, on this clayey soil, when laid down to grass, "not one square foot of the clover froze out." Again he says: "Heretofore, many acres of wheat were lost on the upland by freezing out, and none would grow on the low-lands. Now, there is no loss from that cause."

The growing of winter wheat has been entirely abandoned in some localities on account of freezing out, or winter-killing, and one of the worst obstacles in the way of getting our lands into grass, and keeping them so, is this very difficulty of freezing out. The operation seems to be merely this: The soil is pulverized only to the depth of the plough, some six or eight inches. Below this is a stratum of clay, nearly impervious to water. The autumn rains saturate the surface soil, which absorbs water like a sponge. The ground is suddenly frozen; the water contained in it crystallizes into ice; and the soil is thrown up into spicules, or honey-combs; and the poor clover roots or wheat plants are drawn from their beds, and by a few repetitions of the process, left dead on the field in spring. Draining, followed by subsoiling, lets down the falling water at once through the soil, leaving the root bed of the plants so free from moisture that the earth is not "heaved," as the term is, and the plants retain their natural position, and awaken refreshed in the spring by their winter's repose.

Thorough drainage prevents drought. This proposition is somewhat startling at first view. How can draining land make it more moist? One would as soon think of watering land to make it dry. A drought is the enemy we all dread. Professor Espy has a plan for producing rain, by lighting extensive artificial fires. A great objection to his theory is, that he cannot limit his showers to his own land, and all the public would never be ready for a shower on the same day. If we can really protect our land from drought, by underdraining it, everybody may at once engage in the work without offence to his neighbor.

If we take up a handful of rich soil of almost any kind, after a heavy rain, we can squeeze it hard enough with the hand to press out drops of water. If we should take of the same soil a large quantity, after it was so dry that not a drop of water could be pressed out by hand, and subject it to the pressure of machinery, we should force from it more water. Any boy, who has watched the process of making cider with the old-fashioned press, has seen the pomace, after it had been once pressed apparently dry and cut down, and the screw applied anew to the "cheese," give out quantities of juice. These facts illustrate, first, how much water may be held in the soil by capillary attraction. They show, again, that more water is held by a pulverized and open soil, than by a compact and close one. Water is held in the soil between the minute particles of earth. If these particles be pressed together compactly, there is no space left between them for water. The same is true of soil naturally compact. This compactness exists more or less in most subsoils, certainly in all through which water does not readily

pass. Hence, all these subsoils are rendered more permeable to water by being broken up and divided, and more retentive by having the particles of which they are composed separated, one from another—in a word, by pulverization. This increased capacity to contain moisture, by capillary attraction, is the greatest security against drought. The plants, in a dry time, send their rootlets throughout the soil, and in the moisture thus stored up for their time of need. The pulverization of drained land may be produced, partly by deep or subsoil ploughing, which is always necessary to perfect the operation of thorough draining; but it is much aided, in stiff clays, also, by the shrinkage of the soil by drying.

Drainage resists drought, again, by the very deepening of the soil of which I have already spoken. The roots of plants, we have seen, will not extend into stagnant water. If, then, as is frequently the case even on sandy plains, the water-line be, in early spring, very near the surface, the seed may be planted, may vegetate, and throw up a goodly show of leaves and stalks, which may flourish as long as the early rains continue; but, suddenly, the rains cease, the sun comes out in his June brightness, the water-line lowers at once in the soil, the roots have no depth to draw moisture from below, and the whole field of clover, or of corn, in a single week, is past recovery. Now, if this light, sandy soil be drained, so that, at the first start of the crop, there is a deep seed bed free from water, the roots strike downward, at once, and thus prepare for a drought. The writer has seen, upon deep-trenched land, in his own garden, parsnips, which, before midsummer, had extended downward 3 feet, before they were as large as a common whip-lash; and yet, through the summer drought, continued to thrive till they attained in autumn a length, including tops, of about 7 feet, and an extraordinary size. A moment's reflection will satisfy any one that, the dryer the soil in spring, the deeper will the roots strike, and the better able will be the plant to endure the summer's drought.

Again, drainage and consequent pulverization and deepening of the soils increase their capacity to absorb moisture from the atmosphere, and thus afford protection against drought. Watery vapor is constantly, in all dry weather, rising from the surface of the earth; and plants, in the day-time, are also from their leaves and bark giving off moisture which they draw from the soil. But Nature has provided a wonderful law of compensation for this waste, which would, without such provision, parch the earth to barrenness in a single rainless month. Sir Humphrey Davy found by experiment that 1,000 pounds of soil, perfectly dried in an oven, upon exposure, gained by absorption from the atmosphere, in a single hour, from 3 to 18 pounds of water, a very fertile soil gaining the most and a worthless one the least.

The capacity of the atmosphere to take up and convey water furnishes one of the grandest illustrations of the perfect work of the Author of the Universe. "All the rivers run into the sea, yet the sea is not full;" and the sea is not full, because the numerous great

rivers and their millions of tributaries, ever flowing from age to age, convey to the ocean only as much water as the atmosphere carries back in vapor, and discharges upon the hills. The warmer the atmosphere, the greater its capacity to hold moisture. The heated, thirsty air of the tropics drinks up the water of the ocean, and bears it away to the colder regions, where, through condensation by cold, it becomes visible as a cloud, and as a huge sponge, pressed by an invisible hand, the cloud, condensed still further by cold, sends down its water to the earth in rain.

The heated air over our fields and streams, in summer, is loaded with moisture as the sun declines. The earth has been cooled by radiation of its heat, and by constant evaporation through the day. By contact with the cooler soil, the air, borne by its thousand currents gently along its surface, is condensed, and yields to the thirsty earth again, in the form of dew.

At a Legislative Agricultural Meeting, held in Albany, New York, January 25th, 1855, "the great drought of 1854" being the subject, the secretary stated that "the experience of the past season has abundantly proved that thorough drainage upon soils requiring it has proved a very great relief to the farmer;" that "the crops upon such lands have been far better, generally, than those upon undrained lands, in the same locality;" and that, "in many instances, the increased crop has been sufficient to defray the expenses of the improvement in a single year."

Mr. Joseph Harris, at the same meeting said: "An underdrained soil will be found damper in dry weather, than an undrained one, and the thermometer shows a drained soil warmer in cold weather, and cooler in hot weather, than one which is undrained."

The secretary of the New York State Agricultural Society, in his Report for 1855, says: "The testimony of farmers, in different sections of the State, is almost unanimous, that drained lands have suffered far less from drought than undrained." Alleghany county reports that "drained lands have been less affected by the drought than undrained;" Chatauque county that "the drained lands have stood the drought better than the undrained." The report from Clinton county says: "Drained lands have been less affected by the drought than undrained." Montgomery county reports: "We find that drained lands have a better crop in either wet or dry seasons than undrained."

B. F. Nourse, of Orrington, Maine, states that, on his drained land in that State, "during the drought of 1854, there was at all times sufficient dampness apparent on scraping the surface of the ground with his foot in passing, and a crop of beans was planted, grown and gathered therefrom, without as much rain as will usually fall in a shower of fifteen minutes' duration, while vegetation on the next field was parching for lack of moisture.

Thorough draining warms the soil. It has been stated, on high authority, that draining raises the temperature of the soil, often as much as 15° F. Indian corn vegetates at about 55°. At 45°, the seed

would rot in the ground, without vegetating. The writer, however, has seen rye sprouted upon ice in an ice-house, with roots two inches long, so grown to the ice that they could only be separated by thawing. Winter rye, no doubt, makes considerable growth under snow. Cultivated plants, in general, however, do not grow at all, unless the soil be raised about 45°. The sun has great power to warm dry soils, and it is said will often raise their temperature to 90° or 100°, when the air in the shade is only 60° or 70°. But the sun has no such power to warm a wet soil, and for several reasons which are as follows:—

1. *The soil is rendered cold by evaporation.* If water cannot pass through the land by drainage, either natural or artificial, it must escape, if at all, at the surface, by evaporation. Now, it is a fact well known, that the heat disappears, or becomes latent, by the conversion of water into vapor. Every child knows this, practically, at least, who, in winter, has washed his hands and gone out without drying them. The same evaporation which thus affects the hands, renders the land cold, when filled with water, every gallon of which thus carried off requires, and actually carries off, as much heat as would raise five and a half gallons of water from the freezing to the boiling point.

Morton, in his "Encyclopedia of Agriculture," estimates that it would require an expenditure of nearly 1,200 pounds of coals per day to evaporate artificially one half the rain which falls on an acre during the year. In other words, about 219 tons of coals annually would be required for every acre of undrained land, so as to allow the free use of the sun's rays for the legitimate purpose of growing and maturing the crops cultivated upon it. It will not then be surprising, that undrained soils are in the language of the farmer, "cold."

2. *Heat will not pass downward in water.* If, therefore, your soil be saturated with water, the heat of the sun, in spring, cannot warm it, and your ploughing and planting must be late, and your crop a failure. Count Rumford tried many experiments to illustrate the mode of the propagation of heat in fluids, and his conclusion, it is presumed, is now held to be the true theory, that heat is transmitted in water only by the motion of the particles of water, so that, if you could stop the heated particles from rising, water could not be warmed except where it touches the vessel containing it. Heat applied to the bottom of a vessel of water warms the particles in contact with the vessel, and colder particles descend, and so the whole is warmed.

Heat, applied to the surface of the water, can never warm it, except so far as it is conducted downward by some other medium than the water itself. Count Rumford confined cakes of ice in the bottom of glass jars, and, covering it with one thickness of paper, poured boiling-hot water on the top of it, and there it remained for hours without melting the ice. The paper was placed over the ice, so that the hot water could not be poured on it, which would have thawed it at once. Every man who has poured hot water into a

frozen pump, hoping to thaw out the ice by this means, has arrived at the fact, if not at the theory, that ice will not melt by hot water on the top of it. If, however, a piece of lead pipe be placed in the pump, resting on the ice, and hot water be poured through it, the ice will melt at once. In the first instance, the hot water in contact with the ice becomes cold; and there it remains, because cold water is heavier than warm, and there it will remain, though the top be boiling. But when hot water is poured through the pipe, the downward current drives away the cold water, and brings heated particles in succession to the ice.

Heat is propagated in water, then, only by circulation; that is, by the upward movement of the heated particles, and the downward movement of the colder ones to take their place. Anything which obstructs circulation, prevents the passage of heat. Chocolate retains heat longer than tea, because it is thicker, and the hot particles cannot so readily rise to be cooled at the surface. Count Rumford illustrated this fact satisfactorily, by putting eider-down into water, which was found to obstruct the circulation, and to prevent the rapid heating and cooling of it. The same is true of all viscous substances, as starch and glue; and so of oil. They retain heat much longer than water or spirits.

Thorough drainage supplies air to the roots. Plants, if they do not breathe like animals, require for their life almost the same constant supply of air. "All plants," says Liebig, "die in soils and water destitute of oxygen; absence of air acts exactly in the same manner as an excess of carbonic acid. Stagnant water on a marshy soil excludes air, but a renewal of water has the same effect as a renewal of air, because water contains it in solution. When the water is withdrawn from a marsh, free access is given to the air, and the marsh is changed into a fruitful meadow." Animal and vegetable matter do not decay, or decompose, so as to furnish food for plants, unless freely supplied with oxygen, which they must obtain from air. A slight quantity of air, however, is sufficient for putrefaction, which is a powerful deoxydizing process, that extracts oxygen even from the roots of plants.

Experiments have been tried in England, by leaving open both ends of tile-drains, laid 2 feet deep, and 15 feet apart, to introduce air by circulation through the drains into the soil, and it is stated that there was an increase of 50 per cent. in a crop of turnips by this process of air-drains, over the part of the same field where the ends of the drains were not thus open. That a full supply of fresh air is essential to all vegetation there can be no doubt; but a still further benefit than that of supplying oxygen merely, is derived from thus admitting air.

Thorough drainage promotes absorption of fertilizing substances from the air. The atmosphere bears upon its bosom, not only the oxygen essential to the vitality of plants, not only water in the form of vapor, to quench their thirst in summer droughts, but also

various substances, which rise in exhalations from the sea, from decomposing animals and vegetables, from the breathing of all living creatures, from combustion, and a thousand other causes. These would be sufficient to corrupt the very air, and render it unfit for respiration, did not Nature, with her wondrous laws of compensation provide for its purification. It has already been stated how the atmosphere returns to the hills, in clouds and vapor, condensed at last to rain, all the water which the rivers carry to the sea, and how the well-drained soil derives moisture, in severest time of need, from its contact with the vapor-loaded air. But the rain and dew return not their waters to the earth without treasures of fertility. Ammonia, which is one of the most valuable substances found in farm-yard manures, and which is a constant result of decomposition, is absorbed in almost incredible quantities by water. About 780 times its own bulk of ammonia is readily absorbed by water at the common temperature and pressure of the atmosphere, and, freighted thus with treasures for the fields, the moisture of the atmosphere descends upon the earth. The rain cleanses the air of its impurities, and conveys them to the plants. The vapors of the marshes, and of the exposed manure heaps of the thriftless farmer, are gently wafted to the well-drained fields of his neighbor, and there, amidst the roots of the well-tilled crops, deposit, at the same time, their moisture and fertilizing wealth.

This absorption of moisture goes on at night, even when there is no perceptible dew, and to such an extent, says Johnston, that a clayey soil in a single night often absorbs one-thirtieth part of its own weight, and a peat soil one-twelfth, the power of absorption depending much on the quantity of clay and vegetable matter they contain, and, as has already been seen, upon the pulverization and temperature of the soil.

Thorough drainage improves the quality of crops. In a dry season, we frequently hear the farmer boast of the quality of his products. His hay-crop, he says, is light, but will "spend" much better than the crop of a wet season; his potatoes are not large, but they are sound and mealy. Indeed, this topic need not be enlarged upon. Every farmer knows that his wheat and corn are heavier and more sound when grown upon land sufficiently drained.

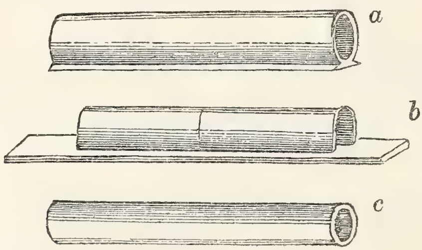
The drainage of high-lands is a subject of more immediate practical importance than that of marshes, swamps, and flats, by the neglect of which our farmers, in the older portions of the Union, are annually suffering immense losses.

Of the methods of drainage, as practised upon high-lands, the books abound in descriptions. The more common methods are, first, draining with open ditches, the most imperfect of all; second, draining with wood, either in the form of tubes, poles, planks, or brush; third, draining with flat stones, constructed in free channels, or with cobble-stones thrown in at random. No one of these methods should be encouraged, except as a matter of mere temporary expediency where proper drain-tiles cannot be procured.

To call attention more especially to the only cheap, practical and systematic course of drainage which can ever extensively prevail in this country, it is proposed to devote a few pages to some brief hints upon the subject of

DRAINAGE WITH TILES.

Those who are familiar with English works on husbandry are aware that drainage occupies a large space in them all, and that drainage with tiles is the only method deemed thorough and permanent. The questions, how deep these shall be laid, how far apart, of what size, whether across the slope or up and down, of what form, and the like, have, for a generation, been kept prominently before the scientific as well as practical agriculturists of Great Britain. Parties have been formed, formal discussions have been held, and lectures delivered; and the injunction, "Prove all things, hold fast that which is good," has been thoroughly applied to this subject. No doubt, the question of the Deanston or Elkington system of drainage, like a political campaign in our own country, has often had the effect of a thunder-storm to neutralize the opposite electricities, purify the atmosphere, and prevent more violent explosions. Soon, the subject will probably receive general attention in this country. Already, tiles are carried hundreds of miles by railroad, and used at a cost of $25 a thousand, which can be made wherever bricks are manufactured at a quarter that cost, or at about the cost of bricks. Tile works are about being erected in several places in New England, and millions will soon be used in every long-settled State.

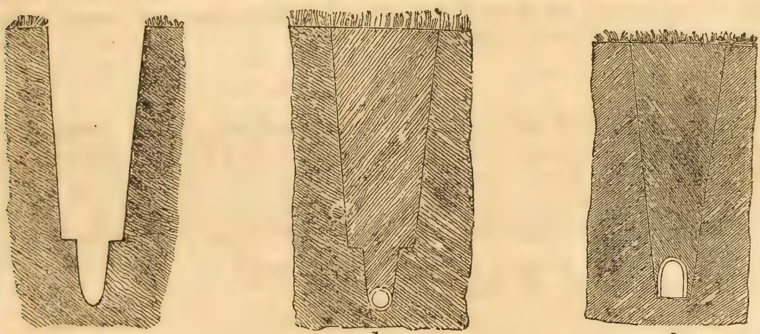


Draining tiles are made of clay, similar to brick-clay, moulded by a machine into tubes, usually 13 inches long, and burnt in a kiln or furnace to be about as hard as what are called hard-burnt bricks. They are of various forms and sizes. Some are round, with a sole or flat bottom moulded with the tile, and are called "sole tiles," as shown in figure *a* above, others are of a horse-shoe form, open at the bottom, to be laid on the hard bottom of the ditch without a sole, or in soft places with a sole or flat bottom of the same material with the tile, made separate from it, as shown in figure *b*. For some localities, pipe-tiles, merely round tubes, as represented in figure *c*, are preferred.

Where there is danger of displacement, by reason of the soft condition of the ground at the bottom of the trenches, pipe-tiles are often kept in position by means of collars of the same material as the tiles themselves, made loosely to fit over the joint, as represented in the following cut:—

The size of tiles to be used varies from 2 to 6 inches calibre, according to the quantity of water to be conveyed. It is a question of expediency whether to use very large tiles, or to lay two or more courses of smaller size, side by side, when the flow of water is very great.

A glance at the following diagrams will give a correct idea of the general process of opening and finishing the drains with the pipes laid:—



a *b* *c*

Figure *a* represents a trench cut in clay ready to receive pipe-tiles; and figure *b*, a section of the same drain finished. Figure *c* represents a section of a finished drain, with a sole tile, as usually constructed in common soil.

Depth and Distance of Drains apart.—There has been in England, for years, a great controversy between the deep-drainers and the frequent or thorough-drainers—a controversy which we have no occasion to introduce into this country. Elkington, who was the father of the deep-draining system, introduced it about 1764. His theory was, that water from springs was the cause of wetness in land; that the leaning or direction of the springs was to be ascertained, and then tap them by boring into them with an auger, where they are below the depth of the ditch.

Frequent or thorough-drainage was brought especially into notice by the late Mr. Smith, of Deanston, in Scotland, about 1832. His leading idea seems to have been, that land is injured as often by water, from rain which falls upon it, as from springs, and that, whatever be the cause of too much wetness, all land may be drained by pipes laid at moderate depth, as 3 or 4 feet, at small distances apart, say from 15 to 60 feet. This, called frequently the Deanston system, from the residence of Mr. Smith, is the prevailing method now practised in Great Britain, and that to which reference will be had in what may follow. No doubt, cases will occur, where a large field may be best improved on the deep-draining system, where a single very deep drain on the upper side may be cut down into an impervious subsoil, which has a regular dip, or inclination, and so the whole flow of water may be intercepted. These cases, however, will probably be found exceptional, and the thorough-drainage system must, without doubt, generally prevail in this country.

It is with fear and trembling that any man, who knows the earnestness, and even violence, with which this subject has been agitated in Great Britain, should enter upon its discussion. The writer, with some, though not long experience in drainage with tiles, is by no means disposed to dogmatize on any controverted point. Some general propositions as to the depth of drains, however, may be laid down with considerable assurance.

Tiles must be laid below the reach of the subsoil plough. Subsoiling should follow thorough-drainage to perfect the work. Indeed, subsoiling is useless upon any ground not well drained, whether by Nature or art. The common plough may turn nearly a foot, and the subsoiler may run 16 inches below that, and tiles should lie far enough below the subsoil plough not to be moved at all by the pressure of it, as it passes over the drains.

Tiles must be laid below frost. Repeated freezing and thawing will not only displace tiles, and so destroy their contiguity, but will soon crumble them to dust. The ground freezes solid in many parts of New England, to a depth of about 3 feet, and occasionally, in exposed spots, not covered with snow, to the depth of 4 feet.

Tiles must be laid below the roots of the crops. Strange accounts are given of the stoppage of drains by roots of vegetables, weeds, and trees. Probably, it would be in vain to attempt to lay drains beyond the reach of poplars or willows; and it would be difficult to set bounds to the roots of vegetables. They will extend often as low as the ground is pulverized and enriched; and, perhaps, no better rule can be suggested on this point than to lay the tiles a foot at least below the lowest depth of cultivation.

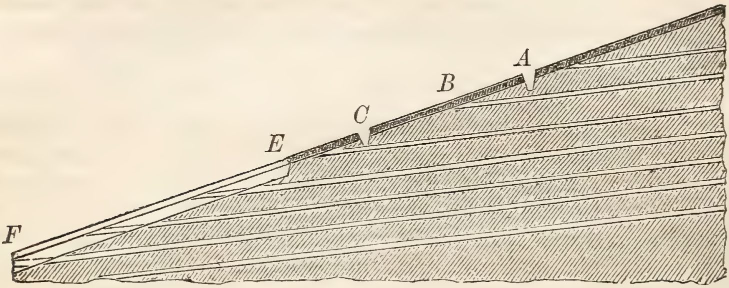
The depth must have reference to the fall and outlet. Drains must of course have a descent. A fall of a foot in 800 has been said to be a practicable descent, and even a fall of an inch in 150 feet, or 3 feet in a mile, has been relied upon where no greater fall could be had; but a much greater fall is desirable. They should have a uniform, or rather, a continuous descent; that is, they should not rise in any place, for, although water will run up tiles as in other tubes, to the level of the head of water behind, yet, if they be thus laid, sand will settle at the lowest parts, and be likely to fill up and destroy the drain.

The depth should be adjusted with reference to the cost. It is a fair estimate, in general, that it costs as much to dig the last foot of a four-foot ditch as the first three. There are but few instances where there is any other objection than the increased cost to laying tiles at the depth even of 5 feet. It is rare that tiles are ever laid too deep, and it is the most common error to lay them too shallow. The least depth at which they should ever be laid in New England is 3 feet, and 4 feet would, in nine cases in ten, be far better.

As to the distance apart at which drains should be made, it is a matter depending so much upon the disposition of the different strata of the subsoil, upon the nature of the soil itself, and upon the depth to which the drains are cut, that a careful study of the details of the subject, or the advice of a practised land-drainer, is necessary to any accurate determination of the point, in a given case. Some stiff clays require three-foot drains at distances of 15 feet, while open, porous, gravelly soils may be well drained by drains of the same depth at 60 feet apart.

The direction of drains with reference to the slope of the fields is another point of much controversy, both in theory and in practice. The argument in favor of cutting them across the slope of the declivity is, that the water is thus intercepted, before it comes out at the surface. This would be true, if the drains were deep enough to cut through, in every instance, to the impervious stratum upon which the water runs out to the surface. The better opinion, however, is, that the drains should run up and down the declivity. The following extract from Morton's "Encyclopedia of Agriculture," illustrates this point, which is deemed one of the first importance in thorough-draining: "In many subsoils there are thin partings, or layers of porous materials, interposed between the strata, which, although not of sufficient capacity to give rise to actual springs, yet exude soft water to indicate their presence. These partings occasionally crop out, and give rise to those damp spots which are to be seen diversifying the surface of fields, when the drying breezes of spring have begun to act upon them. In the following cut, the light lines represent such partings. Now, it will be evident in draining such land

that, if the drains be disposed in a direction transverse or oblique to the slope, it will often happen that they will not reach these partings at all, as at *A*, no matter how skillfully planned. In this case, the water will continue to flow in its accustomed channel, to be discharged at *B*. But again, though it does reach these partings,



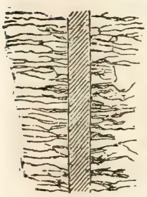
as at *C*, a considerable portion will escape from the drain itself, and flow to the lower level of its old point of discharge, at *D*; whereas, a drain cut in the line of the slope, as from *D* to *E*, intersects all these partings, and furnishes an outlet to them *at a lower level than their old ones.*"

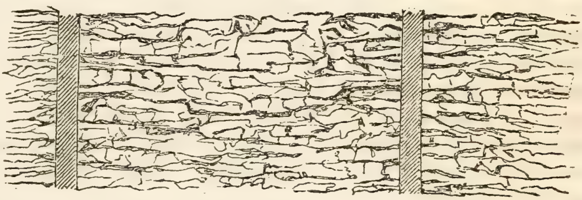
How water enters the tiles is a question which all persons unaccustomed to the operation of tile-draining usually ask at the outset. In brief, it may be answered that it enters both at the joints and through the pores of the burnt clay. It should enter at the bottom of the tiles, and not at the top. It is a well-known fact in draining that the deepest drain flows first and longest. A familiar illustration will make this point evident: If a cask or deep box be filled with sand with one hole near the bottom and another half way to the top, these holes will represent the tiles in a drain. If water be poured into the sand it will pass downward to the bottom of the vessel, and will not flow out of either hole till the water be saturated up to the lower hole, and then it will flow out there. If now water be poured in faster than the lower hole can discharge it, the vessel will be filled higher, till it will run out at both holes. It is manifest, however, that it will first cease to flow from the upper orifice. There is in the soil a line of water, called the "water-line," and this, in drained land, is about at the level of the bottom of the tiles. As the rain falls, it descends, as in the vessel, and, as the water rises, it enters the tiles at the bottom, and never at the top, unless there is more than can pass out of the soil by the lower openings (the crevices and pores) into the tiles. It is well always to interrupt the direct descent of water by percolation from the surface to the top of the tiles, because, in passing so short a distance in the

soil, the water is not sufficiently filtered, especially in soil so recently disturbed, but is likely to carry with it, not only valuable elements of fertility, but also particles of sand, which may obstruct the tiles. This is prevented by placing above the tiles (after they are covered a few inches with gravel, sand, or other porous soil) compact clay, if convenient. If not, a furrow each side of the drain, or a heaping up of the soil over the drain, when finished, will turn aside the surface water, and prevent such injury.

Shrinkage of clayey soils.—There are occasionally stiff clayey soils, which are, in their natural state, impervious to water, or nearly so; and these are the very soils which, without drainage, are absolutely worthless. It would seem, at first view, that such soils could not, from their very constitution, be susceptible of drainage, and were it not for a provision of Nature, which seems specially to aid our labors, such lands must be given over as hopeless.

All soils, and clay in particular, expand when wet, and contract when dry. When drains are laid in clay, the soil next to the tiles is deprived of its water, and, of course, rendered dryer than the rest. This causes it to crack, and the cracks are found by observation to commence at the drains, and extend further and further, in almost straight lines, into the subsoil, forming so many minor drains, or feeders, all leading to the tiles. These main fissures have numerous smaller ones diverging from them, so that the whole mass is divided and subdivided into the most minute portions. The main fissures gradually enlarge, as the dryness increases, and at the same time lengthen out, so that, in a very dry season, they may be traced the whole way between the drains. The following cut will give some idea of these cracks, or fissures, as they exist in a dry time:—





As the soil becomes again wet, the cracks close up, but never so perfectly but that water passes through them. Clay, saturated with water, diminishes in bulk one-fifth on being perfectly dried, which explains this operation of drains in clayey soils, and seems at first hardly credible, though fully supported by experiment.

Many other points of practical interest connected with this subject, present themselves for consideration. Among them the question whether any, and if any, what land can be over-drained, deserves a critical discussion. There is little danger to be apprehended, how-

ever, from error upon that side. Indeed, it may be said, in general, that it is not possible to injure most land in this way; though there are doubtless soils which may be over-drained, for certain crops. The writer feels, however, that an apology is due from him for treating so hastily a subject requiring great particularity of detail, rather than for an omission, in an article of this kind, to enter upon a topic which he has not space properly to consider

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FERTILIZERS.

ON THE VALUE AND USES OF SWAMP MUCK.

BY SIMON BROWN, OF CONCORD, MASSACHUSETTS.

A higher cultivation, on less land, but with more manure, is the great object of modern tillage; and the pursuit of this object has led to the discovery of a material, on large portions of our farms, eminently calculated to restore exhausted lands to fertility, so as to render the soil as productive as when in its virgin state.

Some 40 years ago, these boggy or swampy lands were regarded as nearly worthless for anything except the meagre timber, or fuel, which might be obtained from them, in winter, or the scanty and coarse herbage they afforded to cattle during the summer drought. Such is the change in their value that, where, at the period named, they would scarcely command $5 an acre, they now bring from $30 to $100; and, in the neighborhood of villages located on plain or sandy lands, where they afford the greatest benefit in gardening, they are worth $500 an acre, provided the muck is of good quality, and the deposit deep and of convenient access. Indeed, it is often said by persons about to purchase farms, that they would not enter upon such as are not supplied with meadow muck; for, where it abounds, and a good barn-cellar exists, thrift and prosperity are always certain.

These muck swamps were long avoided as ungenial territory. In the winter, rabbits traversed them with paths, and fed on the bark of the young and tender shrubs; and, in the summer, frogs croaked; slimy things disported themselves securely in their ancestral haunts; snakes deposited their eggs in the rotten logs of an earlier growth, and thence led their supple broods to the heated slopes and rocks to vivify and grow in the sun. It is in these long-abandoned swamps that this vast acquisition to our agricultural wealth is mainly found. In some cases, they are bordered by precipitous or abrupt hills, when the deposit in the basin is usually deep, finely pulverized, and mingled in some measure with mineral matter from these hills.

In others, the high-lands rise gradually, or the swamp is bordered on one or two sides with broad plains of sandy land, once covered with pitch-pines, and possessing within themselves the essential elements of grain-crops for an indefinite period of time. This condition of things reminds the observer of the deposits of coal and iron which frequently lie side by side, divided, perhaps, by a narrow valley or a diminutive stream. Such boggy swamps are not strictly soils, but collections of organic matter mainly contributed by successive ages, into which have been mingled from the higher lands most or all the minerals in a soluble form.

Sometimes, muck of the best quality is found in narrow valleys, and on quite high ground; but, in such instances, it is rarely more than 3 or 4 feet in depth, and thinning down toward the edges of the valley to a few inches. This is usually black, of a slippery, saponaceous appearance, and so thoroughly decomposed that the sense of touch can detect no fibre nor grit when it is rubbed between the fingers. On examining it through a microscope of high power, the fibres may be seen, though exceedingly minute and in endless forms. This muck is perhaps the most valuable of any found for all the purposes for which it is used. It is always accessible, and may be applied to the land with safety when it has been exposed to atmospheric influences for only a few weeks. After it has been thrown out and become dry, it is friable, and falls into a light, fine powder, and in that state is one of the most greedy absorbents in Nature. Instances have come to my knowledge in which this class of muck has been transferred to grass-lands with admirable effect, without any seasoning, or "cooking," as some farmers term it; and without any mixture with barnyard or specific manures, ashes, or lime. When thrown out in ridges, it soon becomes covered with a rank growth of weeds, or coarse grasses, or, what often occurs, a luxuriant growth of the wild raspberry. These are evidences of its virtues which cannot be mistaken, and are sufficient to settle the question of value. In my own garden culture, I have for years used this kind of muck on cultivated raspberries, strawberries, blackberries, currants, and gooseberries, with the most satisfactory results. I also apply it as a mulch about young pear-trees, and young nursery-trees, and find that it prevents excessive evaporation, and protects the tender roots from the scorching effects of our hot summer suns.

On the margins of some small streams, in Massachusetts, I have seen extensive tracts made up of muck, in thickness from a foot to 20 feet. It varies also in quality. These tracts are flooded in the spring, and this is succeeded by annual crops of coarse grasses, which for many ages must have matured and fallen upon the spot, as there re no present evidences of a forest having stood there, though it is upposed they were remotely covered with a heavy growth of trees. They are almost always skirted by rolling hills on one side, and "pine-plains" on the other; thus affording the farmer opportunity to reclaim the meadow itself, by drainage and an admixture of the gravel from the hills, or by transferring the muck to the sandy land, and restoring this to its original fertility. As in the coal and iron

districts, Nature has been affluent in her gifts to the husbandman in this particular, it is for him to seek her treasures, draw them from their hidden recesses, and make them bless the world, or to mould them to his uses where they lie.

In one of the valleys to which I have already alluded, where the muck is from 4 to 8 feet deep, and of the best quality, the substratum is to this day a compact mass of partially-decayed logs. As these approach the surface, the decay is more perfect; and, where one is found in a slanting position, its upper portion has assumed the form of the other materials around it. But, generally, the muck in these pent-up valleys is entirely free from logs and roots. I conclude, therefore, that the accumulation has been gradual, occupying periods very remote, and is made up of annual deposits of grasses, shrubs, and mosses, with slight but constant contributions of mineral matter from the hills, together with immense quantities of the leaves of the forest, which, for successive ages, had been shed upon their sides. When the superincumbent masses are removed, and atmospheric influences find their way to the submerged roots and logs, they, in turn, will become more thoroughly decomposed and fitted for action on the surface.

In the natural peat or muck swamps, the process must have been different, as partially-decayed logs and roots are usually found, and these are, in addition to the materials enumerated above, composing the muck of valleys.

It will be seen from statements already made, that muck of all qualities is mainly composed of vegetable substances. These qualities, however, are affected by the particular location in which the muck is found, by the kind of vegetables of which it is composed, by floods, and, in some degree, by mineral influences. I have preferred to call it by the popular name, "muck," which means a mass of decaying vegetable matter, because that term is at once understood by those who are principally engaged in its use. It has received, however, from scientific inquirers, several other names, and among them, that which is most common is *humus*, the Latin word for earth, or mould. Stöckhardt says: "This term is identical with decaying organic matter. In this acceptation, it has for many years been known and valued in agriculture. Vegetable mould (humus) is the term applied to the upper black or brown layer of earth, which has been formed in forests by the decay of the fallen leaves. The dark, fat, arable soil, containing much partially-decomposed organic [vegetable] matter, is said to be rich in humus, while the dry, light soil, in which it is wanting, is said to be poor in humus. The farmer knows that, contrary to what happens in his woodlands, the humus diminishes in his fields, and so much the more rapidly as the crops are more abundant; he knows that fields rich in humus are, as a general rule, more fertile than those which are poor in humus. * * * * * Accordingly, by the general term 'humus' we must understand a mass of brown, decaying matter, partly soluble, partly insoluble, partly acid and partly neutral, which, with the uninterrupted pres-

ence of air, water, and heat, may be still further decomposed, and carbonic acid and water thereby evolved. Carbonic acid and water are indispensable to the nourishment of plants; hence, in a soil rich in humus, the plants will grow more vigorously, because they find these, and can absorb by their rootlets more of these two nutritive substances than they could in a soil poor in mould. Humus exerts, moreover, a beneficial influence upon vegetation, because it loosens the soil by the development of carbonic acid; because it possesses the power of attracting water from the air, and of retaining it for a long time, and because by means of the acids contained in it, it is able to abstract ammonia from the air, and also from manure, the third means of nutriment of plants."

In extensive low muck swamps, the quality of the material is often widely different, some parts being traversed by running streams, which wash away the rich soluble portions, and leave but the coarser fibre, and others being composed of particular kinds of wood which impregnate the whole mass with acids that are unfavorable to field crops. A striking illustration of this may frequently be seen when these swamps are in the process of being drained, and long ridges of muck are thrown up on the edges of the ditch and allowed to remain undisturbed. If thrown up in the autumn or winter, they will present particular points the following summer covered with a rank growth of weeds or grasses, and thus indicate great fertility in the muck below, while other portions remain entirely bare, or, at best, are partially covered with stinted fungi, or moss. The spots barren of vegetation are sometimes covered with a whitish-yellow substance, light and flocculent, or with sulphate of iron. Muck, of the latter description, spread upon pasture or mowing lands, has been known to prevent the growth of grass for many years in succession ; and, when ploughed and cultivated, aquatic grasses and plants spring up in profusion, and can only be eradicated by a most careful and expensive process of cultivation. Indeed, cases have come under my own observation in which the cost of cultivating a corn-crop has been doubled by the introduction of these plants with this kind of muck, before it had been seasoned or composted; and it was only by high manuring, and constantly stirring the ground, that they were finally subdued. If a few plants only are suffered to come to maturity, the seeds will find their way to every wet spot on the high or lowlands in the vicinity, and, before the cultivator is fairly aware of the fact, a colony of intruders will be established upon his premises, which he will find it exceedingly difficult to eject. The farmer must exercise the nicest discrimination in regard to the matter of quality in the use of muck, or he will be led into errors which may require years of patient toil to remedy.

The circumstances under which muck beds are placed are so various that only a few general rules can be suggested with advantage. Many of these beds cannot be approached with teams, unless it be when the ground is frozen; and the springs and swamps being then usually filled with water, the excavation of the muck becomes an operation of extreme difficulty. Beds thus situated often present so

many obstacles to their removal that, when the farmer is in possession of the most ample stores, he foregoes their advantages rather than encounter the difficulties and expenses required to procure it. The only way in which I have been able to obtain it from such localities is, to take advantage of a severe summer drought, and throw large quantities into high, compact piles, to be hauled away by sled or cart when the surface is sufficient frozen to support a team. If it be near the high-land, and of good quality, it will justify the expense of wheeling it out upon planks laid for the purpose. The valley muck, before alluded to, may usually be removed at once by teams; but, if thrown up and allowed a sufficient time to drain and dry, the expense of carting will be considerably reduced.

The way in which muck is most commonly used, and the most practical and profitable mode is, to collect and store it in a dry state in some place convenient to the droppings of the stalls, and then, from day to day, to spread upon these droppings twice their own bulk of muck. The late Elias Phinney, of Lexington, Massachusetts, who introduced this practice into this section, on a large scale, and whose ample deposits near his barns I have often seen, assured me that he estimated three cords of manure, composted in this manner, at a higher value than three cords of the droppings alone. Perhaps no other man in the country has given this subject so much attention. He displaced acres at a time, by cutting deep ditches, and taking their muck away, and then nearly filling them with stones which had obstructed his labors on the high-lands, and covering them with the nearest muck, and so continued to do until the whole was accomplished. These grounds were then enriched with the compost of which they had furnished the principal part, and two or three tons to an acre of excellent Timothy and red-top hay were their product for some 10 or 15 years in succession. His operations in this matter were extensive and conducted in a systematic manner, and the conclusions at which he arrived, in relation to them, have been abundantly sustained by other manipulators, and by the careful analyses of scientific men.

This mode of preparation requires no uncommon skill, but commends itself to the practice of all, because any common laborer of the farm may accomplish it; and it needs no adjuncts from chemistry, nor from what are called "specific manures." As it is in this particular form that the farmer is to find his chief advantage in using this great gift of Nature, I will briefly present the practices and results of some of the systematic and money-making cultivators whose operations I have long observed, and who stand as worthy examples for all.

Next to the patient, long-continued and valuable efforts of Mr. Phinney, no man's labors have effected more for the public welfare, in this branch of industry, than those of Mr. Frederick Holbrook, of Brattleborough, Vermont: "The floor of my stable," he says, "is just long enough for the cattle to stand or to lie down in comfort. Five feet and three or four inches backward from the manger or standards to which the cattle are tied, is a suitable length of floor for cows, and for young

cattle, generally; for larger animals, the floor should be proportionately longer. Immediately back of this floor, I have a water-tight plank trench, 4 inches deep and 20 inches wide. Between the trench and the outside, or boarding, of the barn, there is a walk or passage-way 2 feet wide. This trench is the place of all places for manufacturing compost manure. In some winters, muck is put into the trench; but in others, leaves and vegetable mould which have been collected in the woods. Last winter, muck was used. It was dug in the preceding August, and piled on dry ground, near the swamp, to drain and lighten; a part of the heap was carted to the barn as soon as the cattle were to be stabled in the fall, and the remainder was hauled by the first sledding, and piled near the stable door, under a shed open to the south side. In the coldest weather of winter, the frost penetrated the pile pretty deeply; but the muck was easily cut up with a sharp pick-axe, and it thawed very soon after being deposited in the trench. I could have readily put the muck in a place usually free from frost, but preferred to have it frozen; for that operated mechanically to break down the lumps, and to divide, pulverize and improve it. A bushel-basketful was put behind each animal every morning. The solid and liquid manure droppings of the day and night fell into the trench upon the muck, the liquid droppings completely saturated it, and the contents of the trench, thus mingled, were thrown out the following morning. In the very coldest days of winter, a thin sprinkling of straw, or other litter, was placed over the bottom of the trench, before putting in the muck, which prevented the latter from freezing to the trench. There were but few days, however, cold enough to make this precaution necessary. The cattle always had a bedding of straw, or other coarse litter, which was daily thrown out with the contents of the trench, and served to swell the manure heap, to keep it up light, and to promote fermentation. The compost was minutely and well mingled every day by this mode, and no shovelling over afterward was necessary. The solid and liquid droppings, falling upon the muck fresh and warm from the animals, and coming in contact with every portion of it, produced an immediate and powerful action on it, so that a much larger quantity of muck was well prepared for use in the spring, than could have been properly prepared with the same stock by ordinary modes of composting. * * * * * It has been a custom with me, for many years, to collect from 10 to 20 cords of this material, composting it variously with the excrements of animals, and applying it for the improvement of tillage fields; and I have not yet seen cause to abandon the custom. True, it would not be advisable to remove this mould indiscriminately from the forests; but, if taken from the hollows and places where it gathers in extra quantities, it soon accumulates again sufficiently for the wants of the trees; and, if it be taken only from these places, leaving the knolls and plains undisturbed, the injury, if any, to the forests, will be more than balanced to the owner by the benefits imparted to his tillage fields and crops. * * * * * If you winter fifteen to twenty head of cattle, you can rearrange

your stable floor, and construct a trench in it, at an expense of about $20; and this, well done, will answer the purpose for years. Then gather materials to put in the trench for compost. If the leaves and mould of wood-lands are conveniently accessible, heap them up in November, and draw the heap to the barn, a few loads at a time, in the winter; or, if there is a room in a shed near the stable, pile it all there. It will not freeze much in the pile. If swamp muck is most convenient, dig it in August, or earlier, and provide a dry warm place for it, in or about the barn, if you choose; although I should prefer to pile it under the shed and let it freeze; for the frost will improve the muck, and with a sharp pick-axe one can easily cleave it from the pile from day to day, as wanted.

"If neither vegetable mould and leaves from the woods, nor muck can be conveniently procured for the trench, then turf, dug and piled in season to rot before being used, rich loam from the road-side, head-lands about the fences, or the wash centering in hollows, may be provided; and, in case such materials are procured, they should be piled in a place pretty much free from frost; for frozen loam is quite a different substance from frozen muck; the latter is spongy, and easily operated on; the former is almost as hard and unyielding as stone. Whichever material is used, it will be well to put straw, swamp-hay, brakes, [ferns,] or other refuse litter under the cattle for bedding, thereby promoting their comfort and swelling the manure-heap. If swamp muck is put into the trench, these light, bulky vegetable substances, used for bedding the cattle, and daily thrown out with the contents of the trench, will cause the heap to lay up lightly, will promote its fermentation, thus expelling the acids of the muck, and preparing it for more immediate use.

"If it is inconvenient to provide one's self with a barn-cellar, the compost will work well thrown out at stable windows, only let there be a roof over the heaps, (a cheap one will do,) to protect them from sun and storms. Even with a cellar, it would still be well to mix the compost in the trench, that being the nicest way, the way to make the greatest quantity of effective manure from a given number of animals. The method of composting manure here detailed may be objected to because of the labor involved. The reply is, that most things of value in this world come to us only as the result of diligent, unremitted labor. He who is content to see around him barren fields, scanty crops, and lean, starving animals, may pass along without devising ways for changing such a condition of things, growling at all propositions of amendment pointed out to him, and reaping such returns as an exhausting, skinning tillage will give him. But it is far better to be up and doing in the manufacture of manure for the invigoration of the soil; it is both pleasanter and more profitable to be pursuing an improving, rather than an exhausting mode of farming." It is not necessary to confirm, by citing the practices of other systematic and judicious cultivators, these statements, though I have many of them at hand.

In spading and ploughing, the observing farmer has often noticed how rankly and luxuriantly, and with what a dark-green color,

plants grow up in the vicinity of a large bone, deposited there, perhaps years before, by some provident dog, or sent from the farm-house and buried out of sight as a nuisance. It is now partially decayed, having a sort of honeycomb appearance, and through it, and interlacing every part, are the delicate rootlets of plants, having travelled several feet, perhaps, in that particular direction, to feed upon the phosphate of lime, in which the bone abounds. Here is "the evidence of things not seen"—the fact laid bare, that *bones will make plants grow,* provided they come in contact. Is it not the part of wisdom, then, not only that all which comes from the kitchen of the farm-house shall be carefully preserved, but that pains should be taken to accumulate them in large quantities, and appropriate them to the advancement of our crops? Suppose this to have been done, and the muck to be ready for composting, then the bones must in some manner be reduced to a powder or paste. The latter is the best form in which to use them, and they may be readily brought into it, by applying 5 pounds of sulphuric acid to every 100 pounds of bone. This acid (oil of vitriol of the shops) costs about 3 cents a pound by the carboy. If the bones have been ground, half this quantity of acid will be sufficient. Take a half-hogshead tub, place it in some convenient spot, and surround it nearly to the top with moist litter or the drier portions of the horse-manure heap, and then, if the tub leaks during the operation, the leakings will be saved. Dilute the acid with three times its bulk of water; place the bones in the tub, and turn on half of the acid and water. In twenty-four hours afterward, stir the mass, and, if the bones are not all dissolved, pour on more of the acid and water, and so continue until the whole is reduced to a pulp or paste. Another method of accomplishing the same object is by making a heap of the bones on a floor; but it is not so safe nor economical as the foregoing method.

When this has been effected, dry, finely-pulverized muck should be intimately mixed with this paste, until the whole will be in such a state as to enable a person to scatter the same with a shovel, or by hand, evenly over the pile of muck with which it is intended to be composted. There is no loss in using the sulphuric aid, as it decomposes the silicates (or sandy particles) in the soil, forming new elements, which are decomposed by the living plants and consumed by them. The materials all being now at hand, the pile may be constructed by a layer of the muck, 6 inches in thickness, then a sprinkling of the bone-dust scattered evenly over it, and so on until the materials are all used. I consider this compost next to muck and barn manure in value, and plenty of instances might be cited to sustain this opinion, were it necessary. Professor J. P. Norton says: "Two or three bushels of these dissolved bones, with half the usual quantity of yard manure, are sufficient for an acre. This is therefore an exceedingly powerful fertilizer. One reason for its remarkable effect is, that the bones, by being dissolved, are brought into a state of such minute division, that they are easily and at once available for the plant. A peculiar phosphate of lime

is formed, called by chemists a 'super-phosphate,' which is very soluble; and, in addition to this, we have the sulphuric acid, of itself an excellent application to most soils.'' In gardening, and especially on the light lands commonly used for that purpose, this compost is one of the most convenient to use, quick in its effects upon the plants to which it is applied, and yet permanent in its results. The farmer cannot exercise too much care in this branch of his industry; for none of his labors will more amply reward him, or produce more gratifying results, than those which he bestows upon his compost heap of muck and bones.

Next to a compost of muck and barn manures, a mixture of muck and ashes is the most common, and by experienced persons is considered the most profitable. It is certainly one of the most convenient mixtures, as the ashes may be transported over a considerable distance without incurring unprofitable expense. The farmer, who does not understand what the precise elements of ashes are, generally accords to them great merit, as a fertilizer. Where they are applied, he finds his plants vigorous, of a fine healthy color, growing permanently throughout the season, and producing highly-perfected and abundant crops; so that their value, to be used with muck, is often estimated as high as 50 cents a bushel, in an unleached state.

In the Agricultural Transactions of Essex county, Massachusetts, for the years 1839–'40, made by Dr. Andrew Nichols, is shown the value of the compost now under consideration. He says: ''I directed a quantity of black peat mud, procured by ditching, for the purpose of draining and reclaiming an alder swamp, a part of which I had some years since brought into a state highly productive of the cultivated grasses, to be thrown in heaps. I also had collected in Salem, during the winter, 282 bushels of unleached wood-ashes, at the cost of 12½ cents a bushel. These were sent up to my farm, a part to spread on my black soil grass-lands, and a part to be mixed with mud for my tillage land. Two hundred bushels of them were spread on about 6 acres of such grass-land, while it was covered with ice, and frozen hard enough to be carted over without cutting it into ruts. These lands produced from one to two tons of good merchantable hay to the acre, nearly double the crop produced by the same lands last year. * * * * * Seventy bushels of these ashes, together with a quantity not exceeding 30 bushels of mixed coal and wood-ashes, were mixed with barn manure. These ashes and this manure were mixed with a sufficient quantity of the mud above mentioned, by forking it over three times, to manure 3 acres of corn and potatoes in hills, 4 feet by about 3 feet apart, giving a good shovelful to the hill. More than two-thirds of this was grass-land, which produced last year about half a ton of hay to the acre, broken up by the plough, in April. The remainder was cropped last year, without being well manured, with corn and potatoes.''

Where ashes cannot be obtained without incurring a considerable expense in transportation, a profitable manure may be made by the use of potash; and it would not perhaps be dearer than ashes at

the prices which they now command in most of the country towns. When the experiments were made that are recorded in the books, ashes could be purchased for from 10 to 13 cents a bushel, while now they readily bring from 17 to 25 cents, and in villages, where good gardens exist, or where there are a few enterprising or scientific farmers, even 50 cents. In another trial, by the gentleman in Essex county, on a crop of onions, he says the experiment satisfied him that nothing better than potash and peat can be used for most, if not all, cultivated vegetables.

Several years ago, I was engaged in a series of experiments in which most of the special fertilizers were tested, such as guano, super-phosphate of lime, ground bones, poudrette, salt, &c. Added to them was a cask of potash, containing 700 or 800 pounds This was dissolved and sprinkled upon beds of old, finely pulverized muck, and an equal value in money of it was applied to the same space of land as was applied in the other fertilizers, and the results were favorable, when compared with the other tests. But the highest results accrued when meadow muck was so deposited as to receive upon itself the sewerage of a large public institution, where the contents of the vaults also passed through the common sewers. This started the plants early, carried them through the season with great activity, and perfected the most ample crops. A gentleman, whose estate I visited, wishing to convert a sunken place in the midst of his park into a pond, after pumping out the water at considerable expense, hauled out between 2,000 and 3,000 loads of excellent muck, such as before described as being found in valleys. This was piled in an oblong form, 3 feet high, the sides neatly laid up, and the top levelled, manured, and sowed with grass-seed; and it afforded two or three abundant crops of Timothy, annually. For many years, this bank has been drawn upon with unvarying success. Small quantities of night-soil are obtained from a village in the neighborhood, and deposited at one end of the bank, when the latter is cut down perpendicularly and spread over the former, the new head still maintaining the height and form of the original. At short intervals, in this heap, stakes are inserted, to be withdrawn after a few days, in order to learn the degree of fermentation which has taken place by the heat indicated by them. When the mass is sufficiently "cooked," it is liberally applied to the land, being about nine-tenths muck, and is followed by the most abundant crops of roots, oats, corn, wheat, and fruits. A large fruit and flower-garden is kept in the most luxuriant condition, mainly through the influences of the discounts from this bank. Rare and beautiful exotics, figs, peaches, apricots, plums, and shrubs in great variety, all find in it that aliment, which, with proper protection, returns to the proprietor ample compensation for the care bestowed. The common manures of the stock of the farm are carefully composted with muck, and husbanded in the most economical manner, and produce highly-gratifying results; but it is principally through the agency of the compost heap, above described, that the lands have been

brought up to a surprising degree of fertility, and that the farm has been deemed worthy of a county premium.

There is no danger of error in regard to the quantity of ashes mingled with muck, only that, in most cases, it will be likely to be too small. About 103 bushels of muck will make a cord; and, if to this could be added 5 bushels of unleached ashes, and 4 cords, or 12 ox-loads of about 34 bushels each, were to be applied to an acre, the effect would be plainly perceptible on any crop in a favorable season. But, on lands hungry for vegetable matter, this allowance should be continued for two or three years. With such a dressing as this, and what manures could be spared from the barn, together with a thorough system of cultivation, even our poorest lands would soon produce permanently remunerative crops; and, once in this condition, it is an easy matter to keep them so.

A compost of muck and oystershell lime has been used with marked effects. On a farm which I had occasion to examine three years ago, all the crops, and the apple-trees, especially, of which there were a large number, had been materially benefitted by it. The proprietor entered upon the farm when it was in a greatly reduced state; and, not being able to raise hay, keep stock, and procure manure through that source, he had recourse to the muck pit and oystershells. He found the former on the farm, but was obliged to bring the latter about eight miles by team; and he piled them up where two stout stone walls met at right angles; and, by building up two other sides, he had a rude kiln, in which he burnt them successfully by mingling brush and billets of wood with them, covering the whole with turf and earth. In this manner, he had reclaimed the whole farm to a comparative state of fertility, had increased the stock in number and value, and had given a new aspect to the whole estate.

In composting muck with stone-lime or oystershell lime, the operation should be conducted in a similar manner in each case. The muck should be old, fine and dry; and the lime, of either sort, should be water-slaked in the common way. Then a beginning should be made with a bed of muck, a foot in thickness on the ground, covering a space 12 feet square, or of any size to suit the quantity intended to be composted. It is better to make a high compact pile than to cover much space, for, in the latter case, little or no heat would be generated, and the mass would lack that fermentation and season, which is requisite to fit it for use. The lime, which is now a fine powder, should be spread over the first layer of muck, and the operation continued in the same manner throughout. The quantity of lime used must be regulated by circumstances in a great measure. If the soil to which it is to be applied abounds in vegetable matter, the quantity may be larger than on land deficient in it. The amount frequently used in England is as great as 200 or 300 bushels to the acre; but this must be on stiff and nearly incorrigible clayey lands, where it is designated that they shall exert a mechanical as well as a chemical influence. I am confident that, on New England soils, small and frequent dressings in the compost form prove the most beneficial. If from 6 to 8 bushels of lime are thoroughly mixed with

100 bushels of muck, and that amount applied for two or three years in succession, it will not only bring good crops during the years of its application, but, added to the other manures usually employed, will give a permanent fertility to the land. On this subject, Mr. Holbrook, already quoted, says: "I have frequently applied a compost of muck with dry, slaked lime, though, when I can buy ashes readily, at not too high a price, I prefer a given outlay in ashes rather than in lime. The best fresh, unslaked lime is the cheapest, because it is more effective in compost, and swells very much in bulk when dry-slaked for use. Six years ago, I had a heap of 75 half cords of muck mixed with lime, in the proportion of a half cord of muck with a bushel of lime. The muck was drawn to the field, when wanted, in August. A bushel of salt to a terce of lime (6 bushels) was dissolved in water enough to slake the lime down to a fine dry powder, the lime being slaked no faster than wanted, and spread immediately, while warm, over the layers of muck, which were about 6 inches thick; then a coating of lime, and so on, until the heap reached a height of 5 feet, a convenient width and length enough to embrace the whole quantity of the muck. In about three weeks, a powerful decomposition was apparent, and the heap was nicely overhauled, nothing more being done to it, till it was loaded the next spring for spreading. The compost was spread on the ploughed surface of a dry, sandy loam, at the rate of about 15 cords to the acre, and harrowed in. The land was planted with corn, and the crop was more than 60 bushels to the acre."

A compost of salt, lime, and muck has also answered well; and, where salt can be obtained at a low rate, say at 15 or 20 cents a bushel, it is well to use it. Salt damaged by sea-water, salt and brine from beef barrels, or that which has been stored and injured by conflagration, may sometimes be procured in considerable quantities, and at low prices. Where it can be obtained in this way, and be conveyed to the land without too much cost, it is economical to compost it with muck, for use on any of our crops. The mode of preparation and quantities used may be like those just stated with regard to lime.

The most common compost, where specific manures are used, is that of muck and guano. In an experiment, a muck-bed was 12 feet by 20, and pulverized guano scattered upon it as the pile was made up. In this condition, it remained from about the middle of March until planting-time. The pile was made up with great care, first, in order to get the guano finely pulverized, and then evenly to distribute it among the whole mass. After remaining in its compact form for two or three weeks, it was carefully and rapidly thrown over, and if any lumps of either material were found, they were broken to pieces upon the floor on which the pile was made. At this time, so great had been the absorbent power of the muck that very little odor escaped from the heap, and the original color of the guano was nearly lost in the prevailing black of the muck. All this was done on a barn-floor, under cover, of course. In such a case, if the muck has become very dry, it will be necessary to give each layer a slight sprinkling with a watering-pot, as the work proceeds.

I believe this mode of using Peruvian guano to be the safest and most econimcal of any yet practised. On lands already abounding in vegetable substances, where it is supposed by some that muck will not be of sufficient service to pay the cost of its application, the guano is only slightly pulverized, and then spread broad-cast upon the field. There is a considerable saving of labor in this mode, but the practice has not yet commended itself so as to lead the farmers generally to adopt it. Even when composted with the care described, and with the greatly preponderating mass of muck over the guano, there is danger that, if the tender germ of the springing corn comes in contact with it, the effect will be fatal. In the experiments made with the pile before mentioned, there were five or six parts of the muck to one of guano. A single handful of this was applied to each hill, and Indian corn dropped upon it; and there were acres together that did not throw a shoot above the ground.

An application of this compost may be made in this way, provided the handful of the mixture is incorporated with the surrounding soil before the corn is dropped upon it; but this greatly increases the cost of planting. The best way, however, is to sow the compost broad-cast; then there will be no danger to the corn, nor grain as small as oats, wheat, barly, or rye. If corn is to be planted, it can then be done at the rate of 10 acres a day, with an approved corn-planter, without missing as many hills as there are acres planted. The idea which prevails so generally, that manure must be directly under the plant in order that it may derive the greatest benefit, is a mistaken one. Nature has not left the plant in so helpless a condition, but has given it the power of sending out its roots in all directions, or in particular directions if it chooses, in search of its own peculiar aliment. If the season be dry, and there is a spot near by containing more moisture than the rest, the plant elects for itself, and sends its roots to feed among the springs; or, if too much moisture prevails, they will take a contrary direction, and feed where it is in just sufficient proportions to give activity to the mineral matters in the soil. Where a highly-cultivated garden is on the border of a mowing field, the gardener finds but few roots next to the field, attached to the trees which have grown near that border. I have seen them where they have grown out a few inches towards the grass, and then turned directly about and run into the mellow soil of the garden. They possess this same power to select their own course in the grain or corn-field, and therefore, it is only necessary to mingle minutely through the soil such fertilizers as we have to apply, and leave it to be appropriated by the roots at such time and in such manner as they please.

The experiments conducted with the pile, named above, of composted muck and guano were in connection with some twenty-five others, all of which yielded to this, except that made with the compost prepared from the muck and barn manure. Ten dollars' worth of guano and muck-compost produced 189½ bushels of superior potatoes from an acre. This is a small crop, compared with those commonly obtained twenty years ago, or even now, on some new lands.

But all the soil on which these experiments were made was light, and had long been under cultivation.

All the specific manures I have named may undoubtedly be used as auxiliaries, and, in particular cases, with profit, even by the common farmer. To the gardener, especially near cities, where he can supply large quantities of the offal and sweepings of the streets, they may be used as quickeners with decided benefit. But, with a mass of evidence before me sufficient to satisfy the most incredulous, I have no hesitation in declaring that the true interest of the farmer is, to depend upon the natural accumulation of his barns, styes, and sheep-folds, together with the ample materials of his ditches, swamps, valleys, and the rich mould of the forest, or that which annually gathers under his walls. These are all rich in the elements of fertility, are safe in their application, sure in their results, and lie directly in the paths in which he finds it his interest, as well as his pleasure, to walk. The showers and winds of heaven, the power of gravitation, the abrasion of rocks, the annual decay of countless tons of grasses and the leaves of trees and shrubs, the overthrow of forests, and the "tooth of time" upon the hills, has been for ages upon ages storing up for the farmer vast deposits of the materials which have been carried off from his cultivated fields in the form of crops, until they lie heavy and barren, and refuse to yield their wonted return. It is for him to observe the indications they present, and avail himself of their treasures, to make glad the land and cause it to blossom as the rose.

Dark loams, or soils which farmers call granite formation, unless they have been severely cropped, are but little benefitted by the application of muck. Such soils have long been favorable to vegetation, as they naturally abound in potash and the other elements upon which plants are lively feeders. They have undoubtedly been covered many times with heavy crops of shrubs, leaves, and grasses, which have fallen to the earth and decayed, and, in one way or another, become partially incorporated with the upper portion of the soil itself. Upon clearing and ploughing this land, these vegetable matters were more thoroughly mixed and turned under, and the whole mass brought into that kindly condition to reproduce luxuriant crops. But even such land as this has been so constantly cropped, and its products carried away without the return of any equivalents, that it has become the fitting recipient of meadow muck. I have known hills and hill-sides so badly treated as to become nearly barren of vegetation on the surface, and the soil itself so sharp and sandy as scarcely to show a vestige of vegetable matter. But upon the application of the muck and manure, muck and ashes, or muck and lime composts, at the rate of 7 or 8 cords to the acre, apple-trees would start with new vigor and produce again liberal crops. So corn, roots, or small grains would produce on such lands almost as abundant as they did before the original fertility was exhausted.

Another kind of land is the sandy plains. These are found in nearly every portion of our country. They appear never to have been charged with vegetable matter; for, even when the forest is cut,

and they are reclaimed and put to rye or other crops, they yield liberally only for one or two years before they require generous manuring. The soil has so little humus that, on washing, it scarcely colors the water. It is loose, porous, and without that firmness which is requisite to keep plants in their places, even if their proper food could be found. They need mechanical, as well as nutritive, change—muck and clay—muck to fill the pores or open places between the particles of sand, and supply proper food when acted on by the salts around it, and clay to bind the whole together and give it that consistence which is found in good granite soils. Such are the lands which require, above all other, the muck and barn-manure composts, especially to start with. If, after one or two years' manuring, or the turning under a green crop of clover or buckwheat, the cultivator desires to produce unusually heavy crops, he may succeed by dressings of the guano, ashes, and particularly the bone-dust composts. I have known plains, the surface of which had not been covered with vegetation within the memory of man, where even the running blackberry (dewberry) vine was thin and feeble, and the scattered stems of St. Johnswort, and the silver five-finger were hardly near enough to be members of the same family, so completely invigorated in the course of three years as to produce 25 bushels of rye, or 2 tons of clover to the acre. And what is remarkable, the lands thus restored to fertility seem as capable of yielding permanent crops under the application of the common dressings supplied by the judicious cultivator, as do those lands which have never been reduced. These plains, heretofore, have been considered of little value, compared with the heavier loams; but I would rather cultivate a corn-crop on them than on the loams, with the same value in money of manure on each. Two acres of them can be cultivated nearly as cheap as one of the heavier lands, because the ploughing, harrowing, and hoeing can be performed with much less team, and find no hindrances from stones. They are also generally level, and offer an advantage in that respect. These are pre-eminently the lands suited for the corn-crop, or for rye, and where they have been ameliorated by clay, for roots which penetrate the ground, carrots, parsnips, beets, mangel-wurzels, and ruta-bagas flourish on them exceedingly.

Another merit of this great gift of Nature is, that it not only retains its good qualities within itself, though exposed to the elements, but possesses the wonderful power of tempering all other soils and bringing them into activity, sometimes by its attractions from the atmosphere, or by yielding up its own virtues to the roots which freely traverse it, and again by the mechanical influences it exerts upon the whole mass where it is introduced. When, therefore, muck is applied to stiff, clayey lands, it still produces those desired results which enable the farmer to cultivate them with pleasure and profit. The first operation on clayey lands, however, must be thorough drainage; for it is time and money wasted to attempt their amelioration with anything so long as cold spring water is permitted to run over the surface, or to stand permanently a few inches below it.

That must be conducted away, the land ploughed in the autumn, and allowed to remain for the elements to work upon until spring. The depth to which it should be ploughed must depend upon the amount of muck which can be spared to incorporate with the up-turned furrow-slice. If muck is convenient and abundant, the soil may be turned up to the depth of 12 inches, with permanent advantage, provided a sufficient quantity can be mingled with it; but, in such case, it would require a large amount, perhaps 100 loads of 34 bushels each, to an acre. If half that depth, then we should use the muck in that proportion. I should prefer the muck and barn-manure compost for a year or two, and then the muck and ashes, or the bone-dust, would produce most beneficial results. But muck, as I have observed, in some form, is suitable for any lands, and may be used to advantage even on its own native beds. Drain it, so that no water shall permanently stand within 15 inches of the top; plough or trench and add alkalies in the form of ashes, lime, or potash; and, if the muck be in minute particles, or what is considered well decomposed, it will produce abundantly of almost any crop of the farm. I have seen cabbages, beets, and many other garden vegetables, growing luxuriantly on it; and, since the rot has affected the potato, that indispensable esculent has been raised on original muck-beds with better success than on any other land.

As to the quantity of muck to be applied to the acre, this depends so much upon the circumstances of each case that no definite rule can be laid down as a guide. I have indicated, in some of the preceding pages, what quantities may be judiciously used in the particular case treated. Those indications may, perhaps, be sufficient for the farmer, even though not practically acquainted with its use. It may be observed, however, that large accumulations of muck are not desirable on up-lands. Ten to fifteen per cent., probably, would be as beneficial as any larger quantity. That amount, with the presence of proper salts in the soil, would supply the plants as well as though the quantity were indefinitely increased.

If muck were always dug and exposed to the action of frost, sun and rain, and overhauled two or three times in the course of the year, its application would be safe at any time; but, as this is not always the case, some regard must be had as to its condition when it is to be incorporated with the soil. I do not think it safe to take low, swamp muck directly from the pit to the field, in the autumn or winter, and plough it under the following spring, as its effects are sometimes of so expensive a character as to prejudice the farmer entirely against its use.

The time may come when people in the large cities will look upon muck as one of the most valuable agents in Nature to preserve health, by absorbing the foul gases which are always generated there, and rendering them innoxious. To the farmer, in his barns, styes, sinks, reservoirs, and cellars, it can scarcely be dispensed with and leave a hope of profitable farming. He covers his steaming heaps with it, and their exhalations are arrested and stored up by this wonderful substance, ready to be given up again to the plants which he desires

should be nourished and perfected by it. Sprinkled upon the floors of cattle or horse-stalls, it readily absorbs the musty odor, and leaves the atmosphere elastic and pure. I have known it applied to vaults, where the odor was nearly suffocating, and in twelve hours, no unpleasant smell was perceptible. I believe it would even conquer sulphuretted hydrogen, steal all its odors, and disarm it of its power. As an absorbent of liquids or gases, then, it has a remarkable capacity, and thus it becomes one of the cheapest and most convenient deodorizers, even for the city, among all the substances used for that purpose. Powdered charcoal would be much more costly, and could scarcely be more efficacious in its effects.

Such are some of the uses, and such is, in fact, the value of this abundant material; yet, with all its merits, it is despised by some and neglected by others, often lying in large quantities totally disregarded, even where it is needed the most. Its value and uses have not yet been laid before the common farmer, in their most favorable light. The writers on this subject have done much for the cultivators who can comprehend them, but these are comparatively few.

Liebig, a German chemist, thought he could judge of the commercial prosperity of a nation by the quantity of sulphuric acid it consumed; and Mr. Pusey, a member of the British Parliament, said it was a good index of its degree of civilization. So we may judge of the character of a nation by the amount and use of its muck heaps. They are the bases of enterprise; they spread gladness through the hearts of the dwellers in cities, as well as over the rural districts; they crown the hills with corn, and the valleys with waving grain; they clothe the fields with grass, and sprinkle the lawn with flowers; fill yielding branches with tempting fruits, freight ships, load cars, and cover our tables with the rich productions of the earth. With them, we may reach almost any degree of civilization; without them, we should gradually relapse into the condition of those originally occupying these fair lands, the objects of our profits as well as of our pride.

DEODORIZATION OF VAULTS AND THE CONVERSION OF NIGHT-SOIL INTO MANURE

BY CHARLES T. JACKSON, M. D., OF BOSTON.

In order to prevent the odors from rising from vaults, we have to fix the gaseous matters by combining them with some substance, which is odorless, or to act upon the fecal contents so as to arrest putrefactive changes. Gypsum (sulphate of lime) strongly acts by the conversion of the ammonia into a sulphate, while the carbonic acid combines with the lime and forms a carbonate, but, by itself, it

proved a very inefficient remedy. Mixed with peat or peat charcoal, it operates very readily and aids in disinfecting the vault. Peat, alone, also operates very favorably, the organic acids in it (crenic, apo-crenic and humic) freely combining with ammonia. In country places and on farms, where peat, swamp muck, or rotten wood can be obtained, it is urgently recommended that they should be put into the vaults and barn-cellars for the purpose of absorbing the ammoniacal products of the liquid and solid manures, which are thus rendered very valuable as fertilizers.

Peat charcoal is highly antiseptic, and absorbs enormous quantities of ammonia and other gaseous matters. Even the odor of a rotten egg is at once destroyed by mixing with the egg a handful of peat charcoal. Wood charcoal in some degree answers the same purpose, but it has not the high absorbing power of peat charcoal. Sulphate of iron, (copperas,) in solution, or still better, mixed with peat, is also a good absorbent of ammonia; and peat, which naturally contains copperas and alum, is particularly valuable for this purpose, and makes, when so composted, a fine manure, containing sulphate of ammonia. Sulphuric acid, diluted with water, and sprinkled in the vault by means of a copper watering-pot, is also an excellent absorbent of ammoniacal gases, and is a good disinfectant. Sulphate of zinc has also been advantageously employed for the same purpose, and a mixture of sulphate of zinc and sea-salt, forming chloride of zinc and sulphate of soda, is a powerful absorbent, and is much used in vaults in Paris. Chloride of zinc, in solution, is largely employed as a disinfecting agent, and, where it can be obtained cheaply, is recommended; but no solid salts, or mere solutions of fixed acids, or salts, will entirely take up the gaseous emanations. I have found by experiment, that muriatic acid is the best deodorizer of vaults; for it acts both as a liquid and by its acid vapor. It is best applied by means of a copper watering-pot, and may then be generally sprinkled over all the fecal matters, and upon the side-walls of the vault, so as to take up all the ammoniacal fumes, and to prevent any sulphide of hydrogen from forming. It may be employed diluted with its bulk of water, when it does not act on copper. This acid may be purchased at the low price of 2½ cents a pound, and it will even be cheaper, if a large demand should call for its being saved in the process of making soda-ash from sea-salt.

The action of the muriatic acid upon night-soil renders it more valuable for manure; for muriate of ammonia is formed, which is a valuable fertilizer, and ammonia is formed, which is also an excellent fertilizer, and the ammonia is readily separated from it, as a carbonate, by mixing with the acidified fecal matter calcareous marl or air-slacked lime, and the carbonate of ammonia may then be absorbed by heat, or any other vegetable compost, or by the organic matters of the soil—the humus, or mould.

It is objected to sulphate of iron that the oxyd of iron forms with phosphoric acid an insoluble and worthless compound. This objection is valid in case the phosphate of iron is not again decomposed

in the compost heap by wood-ashes or some alkaline matter. It is certainly not so good as sulphuric or muriatic acids.

It is not known that the carbonate of zinc, which results from the decomposition of the chloride by the action of carbonate of ammonia of the vault, exerts any injurious effects on vegetation; but it is still a subject worthy of the examination of agricultural chemists.

Peat, unfortunately, does not occur, except in the northern parts of the United States, and hence its use is necessarily limited, and the same remark is applicable to peat charcoal, which is made only at the North, and is unknown in commerce. A mixture of 20 pounds of ground gypsum and 100 pounds of dry peat is an exceedingly powerful absorbent of urine, and wholly prevents any odor arising from it, while the compost formed is very rich in sulphate of ammonia, besides the admixture of all the phosphates, alkaline and other salts of the urine and of carbonate of lime. Such a compost will be found to be as valuable a fertilizer as Peruvian guano, and can be produced by placing barrels filled with the mixture of peat and gypsum at convenient places for the collection of urine, while at the same time the disagreeable odor of urinals may be wholly prevented by this application. In hotels, where these fixtures are so frequently offensive, a sprinkling of muriatic acid in the leaden or wooden gutters is recommended, as it will at once remove all bad odors.

There is another method of generating muriatic acid gas for disinfecting purposes, which has been much employed in sick rooms, in the dead and dissecting rooms of hospitals, and in medical colleges. This, though more expensive than the use of muriatic acid, as generated from sea-salt by sulphuric acid, or the direct use of muriatic acid, is nevertheless worthy of attention. It is, to make use of a common spirit-lamp, filled with what is improperly called chloric ether, namely, a solution of one measure of chloroform and three or four measures of alcohol. This burns with a pale flame, and generates muriatic acid gas and some free chlorine, and will destroy putrid odors with great rapidity. Burn such a lamp until the odor is removed, or until the acid smell of the gas is perceived and becomes sufficiently abundant to dispel the odors, and yet not enough to be disagreeable. This is especially valuable in the rooms of sick persons; for it may be had recourse to in a moment, and on covering the wick, the lamp is extinguished, and there is no evaporation of the fluid. A common burning-fluid lamp may advantageously be applied to this purpose.

When rooms or ship-holds are to be disinfected, an earthen pan of sea-salt should be taken, and oil of vitriol (strong sulphuric acid) poured upon the salt, until enough muriatic acid gas is generated to remove the infection.

Nitrous acid and nitric acid gases are generated by pouring oil of vitriol on saltpetre, and this is often found to act as a good disinfectant. It may be alternated, in certain cases, with the muriatic acid gas fumigation. These methods are particularly recommended for disinfecting ships.

CALCAREOUS MANURES.

By a *manure*, is meant any fertilizing simple or compound substances, which, when applied to a soil under cultivation, tends to promote the growth and perfection of the plants, in supplying them with such nutriment as that soil may be deficient in; and by *calcareous manures*, those in which lime or magnesia enters, in considerable quantities, into their composition, either before or after they have been exposed for a considerable time to the violence of heat, and have lost their humid or volatile parts, or have been decomposed by the action of the weather, or other influences. The latter comprise those substances usually known under the names of *Lime*, *Chalk*, *Plaster*, or *Gypsum*, *Marl*, *Magnesia*, &c.

In treating of these manures, the writer proposes to confine his remarks principally to their natures, properties, sources, and operations, with directions for their preparation and application to the soil, or to crops, as connected with the leading principles of practical and scientific husbandry. Therefore, it well deserves the most exact and careful attention of a practical farmer, to avail himself of every species of information that will throw any light on their uses, application, and their injurious, as well as beneficial effects, on his soils, manures, and crops.

LIME.

Lime, one of the most widely diffused substances in Nature, called by chemists *prot-oxyd of calcium*, is extensively distributed throughout this earth and its inhabitants, combined principally with carbonic, sulphuric, phosphoric, fluoric, humic and silicic acids in the formation of limestone, marble, chalk, marl, calcareous spar, stalactites, stalagmites, gypsum, phosphorite, organic remains, &c. Notwithstanding the immense quantities of carbonate and sulphate of lime, which constitute so large a proportion of the crust of our globe, it is questioned by some, whether lime should not be looked upon as a characteristic of the animal, rather than the mineral, kingdom of Nature. For the bony or testaceous skeleton, by which the softer portions of the animal frame are attached, is always found to consist of lime, united either with carbonic or phosphoric acids. The bones

of all vertebrated animals (those having backbones) are constituted principally of phosphate of lime, while in the shells of the invertebrate animals, (beetles, crabs, lobsters, oysters, &c.,) the carbonate of lime is the prevalent component. The teeth of animals, also, mainly consist of a phosphate of lime which, in all cases, is associated with fluoride of calcium in a similar manner as these substances occur in the mineral phosphorite, or native phosphate of lime. Indeed, it is a remarkable fact, that all the great geological formations, of which lime is the prominent ingredient, are found to consist of the aggregated skeletons, shells, or casts of myriads of invertebrate animals, which had existed at some period long before the creation of man.

From the densest and hardest limestone to the softest chalk, the entire mass generally resolves itself ultimately into a congeries of animal remains; and hence the great supply of lime in the mineral state arises from the destruction of its animal sources. The lime, therefore, which exists in Nature, must be looked upon as being continually in a state of passage between the organic and the inorganic kingdoms. The plants that grow upon the soil take up, by dissolution in their juices, salts of lime, which pass into the substance of the animal that feeds upon them, and accumulating in its system, they afford materials for the proper development of the skeletons, the hair, the skin, and the softer parts.

When the animal dies, the blood, muscles, and other tissues, either serve for the nutrition of some other animal, or, being totally decomposed, its elements return again to a mineral state, to be, in after ages, the subject of similar alternations.

In considering the chemical nature of the ash of plants, it is known that lime, in all cases, forms a considerable proportion of its whole weight. Hence the reason why lime is regarded as a necessary food of plants, and hence, also, one cause of its beneficial influence in general agricultural practice. The quantity of pure lime contained in the crops produced upon one acre, according to Professor Johnston, during a four years' rotation, amounts on an average to 242 pounds, which are equal to about 430 pounds of carbonate of lime in a state of marl, shell-sand, or limestone gravel. It is obvious, therefore, that one of the most intelligible purposes served by this substance as a chemical constituent of the soil, is, to supply this comparatively large quantity which, in some form or other, must enter into the roots of the plants. But all crops do not contain lime in the same proportion, and the quantities are not constant even in the same plant. Wheat, especially, contains much more when it is grown upon land to which lime has been copiously applied, yet, the variable quantities, contained in our economical plants, show that one reason why lime favors the growth of some crops more than others, is, that some actually take up a larger quantity of it in their food. These crops, therefore, require the presence of lime in greater proportion in the soil, in order that they may be able to obtain it so readily that no delay may occur in the performance of those functions, or in the growth of those parts to which lime is indispensable.

This substance is usually obtained by exposing pure limestone or chalk, which are carbonates of lime, to a red heat, and is then popularly known under the names of *stone-lime*, *quicklime*, *hot lime*, *burned lime*, and *caustic lime*. It is also obtained, in an impure state, by burning oyster-shells or the shells of other fish, which converts them into quicklime, and is commonly called *oystershell lime,* or simply *shell-lime.*

When stone-lime is exposed to the air, it rapidly absorbs water, and falls to a pure, white, earthy powder, increasing two or three times its bulk, and forming a hydrate of lime, which is usually known under the name of *air-slacked* or *spontaneously-slacked lime.* If a little water be sprinkled upon a small piece of well-burned lime, it is instantly absorbed, and the lime slakes, or quenches, and appears quite dry; but, after a few moments, it cracks, swells, and crumbles into a powder of hydrate, popularly known as *slaked lime,* sometimes involving sufficient heat to inflame gunpowder, or to char wood. Burned or quicklime is immediately soluble in water; unburned lime is not so to any appreciable extent. When pure, it is soluble in 635 parts of water at 32° F.; but requires at 60°, 778 parts; at 130°, 972 parts; at 212°, 1,270 parts for its solution. A pint of water at 32°, desolves $13\frac{1}{4}$ grains; at 60°, $11\frac{3}{5}$ grains; and at 212°, $6\frac{7}{10}$ grains. Hence the propriety of employing cold water for the slaking of lime. This degree of solubility is quite sufficient, immediately after liming the land, to provide the plants, which, besides, can only bear a very dilute solution of mineral substances without injury, with an abundant supply of digestible lime; that is, of course, supposing that the requisite quantity of water is present. As this solution permeates the soil in all directions, the other actions, which lime generally is capable of exercising upon the constituents of the soil, commence and are continued here more rapidly than with the unburned kinds of calcareous manures, marl and chalk, for instance, which are first rendered soluble by the humus and the carbonic acid produced by its decomposition.

Clear lime-water has an acrid, slightly-caustic taste, but when boiled, it becomes white or turbid. Exposed to the air, it absorbs carbonic acid, and becomes covered with a crystalline pellicle of carbonate of lime. On breathing into transparent lime-water through a glass tube, it is immediately rendered turbid, or milky, by the carbonate of lime, produced by the carbonic acid of the breath, an excess of which acid, however, dissolves the precipitated lime, and the water again becomes clear. It is in this way that carbonate of lime is held in solution in the water of almost every river and spring.

If lime be perfectly dry, it has little or no tendency to absorb carbonic acid. It requires first to be "air-slacked," or "slaked" with water, and then the hydrate is decomposed, the water being expelled by the carbonic acid, the absorption of which is very rapid, until the lime becomes half saturated, when a compound is formed, known under the name of *mild lime,* but after that point, its advancement is very slow. The term *mild* is also applied to lime when it is entirely in a state of carbonate. When strongly heated, lime becomes

phosphorescent, and emits a brilliant light, on which account it is sometimes employed for illumination, as in the Drummond and Gurney lights.

Carbonate of Lime.

Pure carbonate of lime, when perfectly dry, which occurs in the form of marble, or common limestone, consists of lime and carbonic acid, in the following proportions:—

	Per cent.
Carbonic acid, - - - - - - - -	43.7
Lime, - - - - - - - - -	56.3
	100

Thus, 100 pounds of carbonate of lime contain $43\frac{7}{10}$ pounds of carbonic acid, and $56\frac{3}{10}$ pounds of lime; or a ton (2,000 pounds) of pure carbonate of lime contain 1,126 pounds of lime.

Bi-carbonate of Lime.

Lime is sometimes combined with a double proportion of carbonic acid gas, in which state it is called a *bi-carbonate*, and to a certain extent is readily soluble in water. Hence, springs are often impregnated with it, and the waters that gush from fissures in lime rocks, distribute it through the soil in their neighborhood, which is a mode Nature very frequently adopts in fertilizing the earth. Here let it be remembered that carbonate of lime, though insoluble in pure water, may be dissolved to a considerable extent in that which is impregnated with carbonic acid gas; and that, when it holds lime in this way, and is exposed to the air for a length of time, or is heated over the fire, the lime will again separate from it more or less completely. In this manner stalactites are formed in caves; substances are petrified in lakes and streams; beds of marl, in some cases, are produced; drains are often choked up with lime; and crusts are deposited at the bottoms of kettles and steam-boilers.

Limestones, however, are seldom pure. They always contain a considerable quantity of other earthy matter, chiefly silica, alumina, magnesia, and oxyd of iron, with a trace of phosphate of lime, sometimes of potash and soda, and often of animal and other organic remains. In limestones of the best quality, the foreign earthy matter, or impurity, does not exceed 5 per cent. of the whole, while it is often much less. The chalk and mountain limestones are generally of this kind. In those of inferior quality, it may amount to 12 or 20 per cent.; while many calcareous beds are met with in which the proportion of lime is so small, that they will not burn into agricultural or ordinary building lime, refusing to slake, or fall to powder, when moistened with water. Quicklime, of course, will contain a less amount of lime in proportion to the superiority of the limestone from which it has been burned.

When the carbonate of lime, which is contained in marble, common limestone, or in the shells of oysters and other shell-fish, is exposed to a high temperature, in the open air, the carbonic acid they hold, in combination with other ingredients, is driven off by the heat, and the lime remains behind in a caustic state. They are decomposed more readily when a current of moist air is allowed to pass through the burning mass. Hence, on a large scale, this process is performed in kilns. A ton (2,000 pounds) of good limestone yields 1,126 pounds of caustic lime, the weight of which per bushel varies with the kind of stone employed, and with the manner in which it is burned. In some varieties of lime, a bushel does not weigh more than 75 pounds; while in others, it will weigh nearly or quite 100 pounds. This difference shows how uncertain the quantity of lime applied to the land may be when it is estimated by the bushel. Therefore it should be bought and applied by weight.

The following table by Professor Johnston exhibits the chemical changes which a ton (2,240 pounds) of pure limestone undergoes, and the relative proportions in which the several compounds exist in it after it has been burned, slaked, and then exposed to the air, or mixed with the soil:—

Composition.	Lime-stone.	After burning.	After slaking.	Spontaneously slacked.	Exposed to air or in the soil.
	Cwt.	Cwt.	Cwt.	Cwt.	Cwt.
Lime,....................	11¼	11¼	11¼	11¼	11¼
Carbonic acid,..........	8¾	.....	.....	2¾	.....
Water,....................	.....	.....	3½	1¾	8¾
Total weight,.....	20	11¼	14¾	15¾	20

Burning and Slaking.—The form of kilns employed in burning lime varies; some being constructed inside in the shape of a hogshead, or of an egg, opened a little at each end, with the diameter at the bottom small, gradually widening towards the middle, and then contracting again toward the top; while others are made in the form of a sugar-loaf, with the small end down; others, again, are of an oblong-oval, in the ground-plan, as well as at the middle and top. The first of these forms is most generally in use, and when the sides are nearly perpendicular, it is observed that less fuel is necessary in consequence of the great degree of heat that is created, above that which occurs in kilns formed in the shape of a sugar-loaf reversed. Near the bottom of large kilns, two or more openings are made for admitting the air necessary for supplying oxygen to the fire, and for dragging out the lime after it is burned.

Lime-kilns may be built either of stone or bricks; but the latter are considered preferable, particularly for the inside lining, as they are better adapted to stand a high degree of heat. They should always be situated at, or near, the quarry, and if possible, in the side

of a cliff or bank; or they may be furnished with a "ramp," or inclined plane of earth or stone, for carting up the fuel and limestone to their tops.

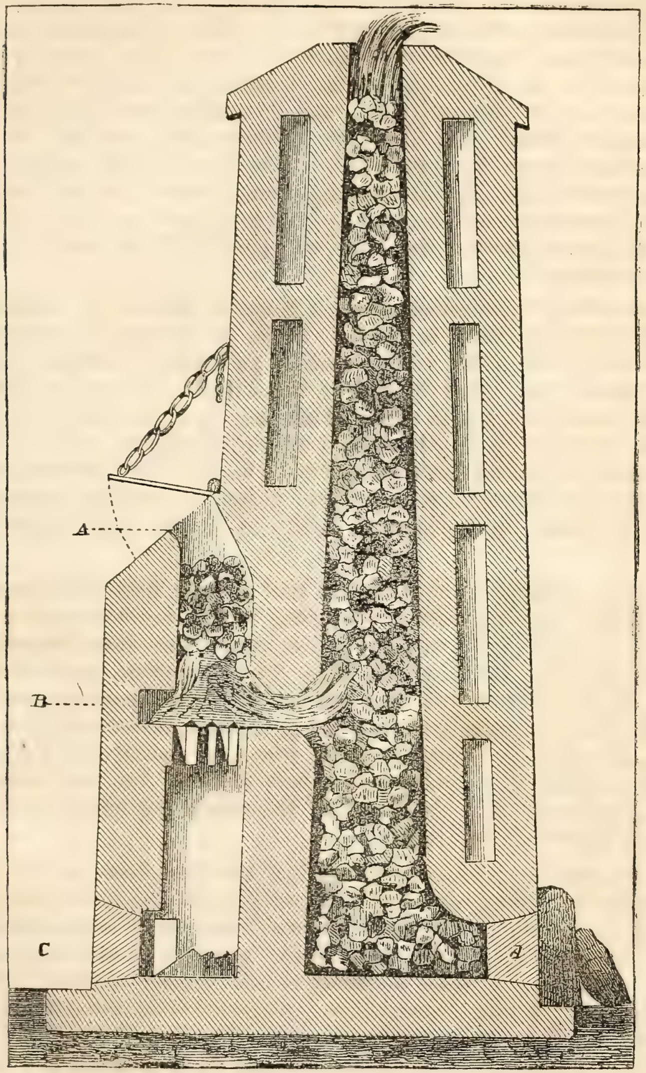
As the improvement of kilns is a matter of great national impor' ance, especially since the use of lime as a manure has become so general, and more particularly so as the price of it is every day increasing, owing to the increased and increasing demand for fuel, I would offer one that was invented by our distinguished countryman Benjamin Thompson, (Count Rumford,) and erected at Dublin, in Ireland, which, as far as is known, answered the Count's expectations, with a view of suggesting such improvements or alterations as may tend to bring it, or something resembling it, into general use. In order that the inventor's ideas of what he calls a "perpetual" kiln may be clearly understood, I will give a description of it with a section as shown in the accompanying diagram. The objects which he had in view were, first, to cause the fuel to burn in such a manner as to consume the smoke, which was effected by obliging it to descend and pass through the fire, in order that as much heat as possible might be generated. Secondly, to cause the flame and hot vapor, which rise from the fire, to come in contact with the limestone by a very large surface, in order to economize the heat, and prevent its going off into the atmosphere, which was done by making the body of the kiln in the form of a hollow, truncated cone, and very high in proportion to its diameter; and by filling it up quite to the top with limestone, the fire being made to enter near the bottom of the cone. Thirdly, to make the process of burning lime perpetual, in order to prevent the waste of heat, which unavoidably attends the cooling of the kiln in emptying and filling it, when to perform that operation it is necessary to put out the fire. And fourthly, to contrive matters so that the lime in which the process of burning is just finished, and which, of course, is still intensely hot, may, in cooling, be made to give off its caloric in such a manner as to assist in heating the fresh quantity of limestone, with which the kiln is replenished, as often as a portion of lime is taken out of it.

To effect those purposes, the fuel is not mixed with the limestone, but is burned in a close fire-place, which opens into one side of the kiln, some distance above the bottom of it. For large kilns, on these principles, there may be several fire-places, all opening into the same cone, and situated on different sides of it, which fire-places may be constructed and regulated like those of the furnaces used for burning porcelain or earthen-ware.

At the bottom of the kiln, there is a door, which is occasionally opened to take out the lime. When, in consequence of a portion of lime being drawn out of the kiln, its contents settle down, or subside, the empty space in the upper part of the kiln, which is occasioned by the removal of the burned lime, is immediately filled up with fresh stone. As soon as a portion of lime is taken away, the door by which it is removed, must be immediately shut, and the joinings well closed with moist clay, to prevent a draft of cold air

through the kiln. A small opening, however, should be left for reasons presently to be explained.

As the fire enters the kiln at some distance from the bottom, and as the flame rises as soon as it comes into this cavity, the lower part



of the kiln (that below the level of the fire-place) is occupied by lime already burned; and as this lime is intensely hot, when, on a portion of lime being removed from below, it descends into this part

of the kiln, and as the air in the kiln, to which it communicates its heat, must rise upward in consequence of its being heated, and pass off through the opening at the top of the kiln, this lime in cooling, by this contrivance, is made to assist in heating the fresh portion of cold limestone with which the kiln is charged. To facilitate this communication of heat from the red-hot lime just burned to the limestone above, in the upper part of the kiln, a gentle draft of air through the kiln, from the bottom to the top of it, must be established, which is done by leaving an opening in the door below, by which the cold air from without may be suffered to enter the kiln. This opening (which should be furnished with a register of some kind or other) must be very small; otherwise, it will occasion too strong a draft of cold air into the kiln, and do more harm than good; and it will probably be found to be best to close it entirely, after the lime in the lower part of the kiln has parted with a certain proportion of its heat.

The preceding description gives a general idea of the manner in which this kiln is made to operate while in the act of calcination. The following will refer to the section as being descriptive of the several parts of it: The height of the kiln is 15 feet, its internal diameter below, 2 feet, and above, 9 inches. In order more effectually to confine the heat, its walls, which are of bricks and very thin, are double, and the cavity between them is filled with dry wood-ashes. To give greater strength to the fabric, these two walls are connected in different places by horizontal layers of bricks which unite them firmly.

A, is the opening by which the fuel is put into the fire-place. Through this opening, the air descends which feeds the fire. The fire-place is represented nearly full of coal; the flame passing off laterally into the cavity of the kiln, by an opening made for that purpose at the bottom of the fire-place. The opening above, by which the fuel is introduced into the fire-place, is covered by a plate of iron, movable on hinges; which plate, by being lifted up more or less by means of a chain, serves as a register for regulating the fire. A section of this plate and of the chain by which it is supported are shown in the figure.

B, is an opening in the front wall of the fire-place, which serves occasionally for cleaning out the fire-place, as also for cleaning out the opening by which the flame passes from the fire-place into the kiln. This opening, which must never be quite closed, serves likewise for admitting a small quantity of air to pass horizontally into the fire-place. A small proportion of air admitted in this manner has been found to be useful and even necessary in fire-places, in which, in order to consume the smoke, the flame is made to descend. Several small holes for this purpose, fitted with conical stoppers, may be made in different parts of the front wall of the fire-place. At the bottom of the fire-place is a grate, constructed of bricks, placed edgewise, and under this grate, there is an ash-pit; but as no air must be permitted to pass up through this grate into the fire-place,

the ash-pit door, *C*, is kept constantly closed, being only opened occasionally to remove the ashes.

D, is the opening by which the lime is taken out of the kiln; which opening must be kept well closed, in order to prevent a draft of cold air through the kiln.

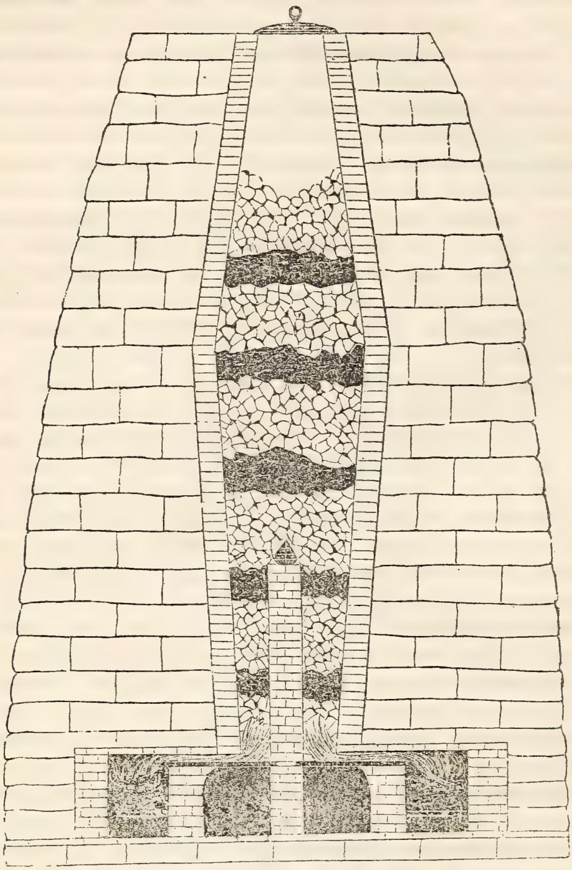
As only so much lime must be removed at once as is contained in that part of the kiln which lies below the level of the bottom of the fire-place, to be able to ascertain when the proper quantity is taken away, the lime, as it comes out of the kiln, may be directed into a pit, sunk in the ground in front of the opening, by which the lime is removed, this pit being made of a proper size to serve as a measure. While the lime is removing from the bottom of the kiln, fresh limestone should be put into it above; and during this operation the fire may be damped by closing the top of the fire-place with its iron-plate. Should it be found necessary, the fire, and the distribution of the heat, may, in burning the lime, be further regulated by closing more or less the opening at the top of the lime-kiln with a flat piece of fire-stone, or a plate of cast-iron. The double walls of the kiln, and the void space between them, as also the horizontal layers of bricks by which they are united, are clearly and distinctly expressed in the figure. The kiln is represented as being nearly filled with limestone.

Another kiln of approved construction, suitable for burning lime with coal, or other dry, smokeless fuel, is denoted by the next diagram. It is supposed to be built at the side of a bank or cliff, of a circular form within, 32 feet high from the iron grating over the pits, 3 feet in diameter at the top, and 7 feet across, near the middle, at a point 18 feet above the grating. The walls are designed to be built of stone, from 3 to 6 feet thick, and lined with bricks. Below the shaft, or hollow of the kiln, are two arches or pits, each 3 feet wide and 3 feet high, divided by a partition wall, 18 inches thick, extending up the shaft 10 feet. About 18 inches from each arch, or pit, is an oven, say 2½ feet square, where coal is used for fuel, and somewhat deeper, where wood is employed, communicating with the shafts by narrow flues. Below the shafts, are two movable iron grates for dragging out the lime after it is burned. The ovens, as well as the arches under the shaft, are provided with iron doors, which are to be closed whenever it is desired to stop the draft. An iron cap, or cover, is also provided to be placed over the top of the kiln, to prevent the escape of more heat than is necessary to keep up the combustion of the fuel. This cap is also furnished with a damper, or valve, for regulating the draft.

In a kiln like this, it is obvious that the limestone can be well burned, with a comparatively small amount of fuel, in winter as well as in summer, and that the farmer or others can be supplied with lime, at any time, without extinguishing the fire. All that is necessary to be done, is, to supply the broken limestone, and the fuel at the top of the kiln, and rake out the burned lime through the iron grate, or opening, at the bottom, as fast as occasion may require. In case it may be necessary to check the burning for a time, nothing

more need be done than to close the iron doors at the bottom of the kiln, and the cover, or cap, at the top, when the fire may be kept alive for four or five days.

When the kiln is to be filled, the limestone should be broken into pieces about the size of a man's fist, and laid in alternate layers with the coal, usually in the proportion of three of the former to one of the latter; but as limestones vary much in their character, the proper quantity of fuel can only be regulated by trial. The coal should



not be placed nearer the lining of the kiln than 8 or 9 inches, in order that the bricks may not melt nor burn.

When newly-burned lime is taken from the kiln, it has a strong tendency to "drink in" and combine with water. Hence, when exposed to the atmosphere, or covered over with sods in a shallow pit, it slowly absorbs moisture from the air, without developing much heat, increases in weight, swells, and gradually falls to powder. In this case, it is said to be *air-slacked*, or *spontaneously-slacked*. In

rich limes, the increase of bulk may be from 3 to 3½ times; but in the poorer varieties, or such as contain much foreign matter, the increase may be less than twice their bulk.

If water be sprinkled or thrown upon the kind of lime named above, or if it be immersed in water for a short time, and then withdrawn, it absorbs the water, becomes hot, cracks, swells, throws off much watery vapor, and falls down in a short time to a bulky, more or less white, and almost impalpable powder. When the thirsty lime has thus fallen, it is said to be *slaked*, or *quenched*. If more water be added, it is no longer "drunk in," but forms with the lime a paste; and, if sharp sand be added, a *mortar* is formed. In slaking, the water combines chemically with the lime; 3 pounds of which, when pure, take up a pound of water, and give 4 pounds of pulverulent, slaked lime. The more uniform and complete the operation of slaking, the finer the powder of the lime will be, and consequently the more equally it may be incorporated with the soil. Either excess or deficiency of water interferes with the uniform slaking. These effects are more or less rapid and striking, according to the quality of the lime, and the time that has been allowed to elapse after the burning, before the water was applied. All lime becomes difficult to slake when it has been for a long time exposed to the air. When the slaking is rapid, as in the rich limes, the heat produced is sufficient to kindle gunpowder strewn upon it, and the increase of bulk as before stated is from 2 to 3½ times. If the water be thrown on so rapidly or in such quantity as to chill the lime or any part of it, the powder will be gritty, will contain many little lumps, which refuse to slake, and will also be less bulky and less minutely divided, and therefore less fitted either for agricultural or building purposes.

It may be received as a general rule, however, that the best mode of slacking lime for agricultural purposes, is that which gives it the greatest, and reduces it to the most minute state of division. For the following reasons, the spontaneous method is preferred by many, as it is thought to be more economical and has a better effect on the crops to which it is applied. First, it causes the lime to fall to the finest powder; and secondly, it is the least expensive, requiring less care and attention, and exposes the lime least to become "chilled" and gritty; but when thus left to itself, it should be laid up in heaps, covered with sods, and allowed to remain a sufficient time to slack, in order to prevent the surface of the heaps from being chilled, or the whole converted into mortar by large or continued falls of rain; also to exclude the too free access of the air, which gradually brings back the lime to a half state of carbonate. Hence, the lime may be laid up in heaps, in the field in the winter, covered with sods, and left until it has completely fallen, or until the time is convenient for laying it upon the land, in spring or summer, when preparing for the ensuing crops.

The Use of Burned Lime as an Application to the Soil.—The application of burned lime to the soil is of high antiquity, and its utility is such as has been recognized in almost every country in which agri-

culture has obtained much eminence; and certainly it has been more largely and extensively used as a fertilizer from a very remote period than any other mineral substance that has ever been made available in practical husbandry. Cato describes with much minuteness the best means of preparing it; and Pliny attests the use of slaked lime by the Roman cultivators as a dressing for the soil in which fruit-trees were grown. It was also applied with equal success by the Arabs in Spain. Hence it may be inferred that what has been good in all ages past is good at the present time.

When lime is applied to the soil, it is believed by some that it acts in two ways—one, as a *stimulant* that promotes vegetation by causing the soil with which it is mixed to exert itself, and the other, in promoting the growth of trees and plants by enriching the land as a *manure*, and adding to the quantity of vegetable food. By others, it is looked upon in a *chemical* and *medicinal* point of view, acting as an alterative, a corrector, a dissolver, or a decomposer—a disengager of certain parts of the animal, vegetable and mineral substances contained in the soil, and as a retainer and a combiner with others, but not as a substance, like dung or decayed organic matter, fit for the immediate use and nourishment of plants, except in small proportions. It also produces a mechanical alteration in the soil, which is simply and easily understood, and is the cause of a series of chemical changes that are really obscure, and are as yet susceptible of only partial explanation. In the finely-divided state of quicklime, or slaked lime, or of soft and crumbling chalk, it stiffens very loose soils and opens the stiffer clays; while in the form of limestone gravel or of shell-sand, it may be employed either for opening a clayey soil or giving body and firmness to boggy land. Thus, it proves very useful in tenacious, heavy, clayey soil, while it may be dispensed with in light ones, as scarcely, if at all, affecting them.

The purposes served by lime as a chemical constituent of the soil are at least of four distinct kinds, namely: First, it supplies a kind of inorganic food which appears to be necessary to the healthy growth of all cultivated plants. Secondly, it neutralizes acid substances, which are naturally formed in the soil, and decomposes or renders harmless other noxious compounds, that are not unfrequently within reach of the roots of plants. Thirdly, it changes the inert vegetable matter in the soil so as gradually to render it useful to vegetation. Fourthly, it causes, facilitates, or enables other useful compounds, both organic and inorganic, to be produced in the soil, or so promotes the decomposition of existing compounds as to prepare them more speedily for entering into the circulation of plants.

Burned or quicklime is of an *alkaline* or *basic* nature like potash and soda. Bodies of this kind form the chemical opposites to those of an acid nature; that is, they deprive them of their sour taste, and their acid properties and actions, in general, when they combine with them, while on their own side, they give up their basic properties. For instance, from the most corrosive hydro-chloric acid, and the most caustic soap-boiler's lye arises a compound which no longer tastes sharp or caustic, but only mildly saline, namely, common table

salt. Their mutual resignation and delivering up of their characteristic properties, which occurs in all cases where an alkaline base meets with an acid, is called *neutralization*, and a new product arising from the two is termed a *salt*.

A good soil, in a state of readiness for culture, must not possess any acid properties. All the cultivated plants grow less freely and less vigorously in soils containing acids, than in such as are weakly basic, or even neutral, and their growth becomes inferior in proportion as the quantity of acid in the soil increases. The production of acids takes place in every soil; for the humus, which originates both from the remains of plants and refuse remaining in the ground, and from stable manure, is of an acid nature; the soil, however, usually contains in its mineral constituents so many bases, (lime, magnesia, potash, and soda,) while the nitrogen of the stable-dung produces another, (ammonia,) that these suffice to neutralize the acids formed, and to convert the acid into tempered or neutralized humus. Combined with bases, the humus undergoes a far more rapid and extensive decomposition into food for vegetation; that is, into soluble substances applicable to the growth of plants, while the acid humus, whether produced by want of moisture, or by a superabundance of peaty substances, undergoes further decay, but slowly and with difficulty.

Lime is not merely a *base*, but a *very strong base*, and can therefore even extract from the weaker bases occurring in the soil the acids with which they are already combined. Hence, it acts with advantage in those cases where weaker bases are such as become soluble by combination with acids, and are in this condition capable of interfering with the growth of plants. Of this kind especially are the bases which originate from the ferruginous particles present in all soils covered with water, such as are situated in low-lands excluded from the access of atmospheric air by a tenacious covering. Humic and carbonic acids produced in such places render the particles of prot-oxyd of iron soluble, and these again cause the soil to become sterile or less fertile, just like the water which we see in ferruginous springs flowing from deposits of lignite or peat. On this account, fresh, black mud from ponds or lakes always acts injuriously upon fields and meadows the first years; hence the dead subsoil, when mixed at once with the surface soil, so often causes a diminution of fertility for one or more years. In like manner, in a soil which contains much pyrites, the oxygenation, or weathering, of the ground may readily produce so much soluble salt of iron (green vitriol, or sulphate of iron) as to disturb the growth of plants. In all these cases, lime is an excellent means of rendering the iron insoluble, and, at the same time, of giving it a tendency to absorb oxygen from the air more rapidly and abundantly, whereby the black prot-oxyd of iron is changed into brown per-oxyd, (iron-rust,) which no longer acts injuriously upon vegetation.

Caustic or quicklime, as its name indicates, attacks the skin of the hand and dissolves it in washing, in the same way as potash or soda lye, and has a similar action upon other animal and vegetable

substances, as many farmers, perhaps, have noticed on the sacks in which they have kept lime, which soon become rotten and soft. When lime is mixed with the soil, it acts in this *decomposing* and *dissolving* manner upon roots, leaves, straw, and other parts of vegetables, as also upon organic constituents of the soil, which are already partially converted into humus. It hastens the decomposition of those substances which are often very slow and disinclined to fermentation in heavy soils, not freely admitting atmospheric air to a greater activity; that is, to a more rapid fermentation, putrefaction, and decay, whereby they are decomposed into carbonic acid and ammonia, which are then absorbed by the roots of the living plants as the most important of all their food. The action which lime exerts in this way clearly agrees in appearance with that produced by direct fertilizers, such as stable manure, guano, &c. But there is this great difference between the two. The lime does not work with its own material, but at the expense of other matter, namely, at that of the land or of its strength, while the direct manures act with their own power. It is, therefore, self-evident that the latter enrich the soil, while lime renders it poorer. The universal effects of this *independent, unmixed* liming or marling of land, which has been established by practice in Europe, as well as in many parts of this country, is obvious not only by the well-known German saying, "Rich father, poor children," but also by the still more precisely expressed maxim,

> "Much lime and no manure,
> Make both farm and farmer poor."

Besides, on heavy, inactive soils, lime may be expected to produce good effects by its decomposing and dissolving power in all cases where the soil is rich in organic remains, especially when the air has not had free access to it; consequently, on new ground, reclaimed from forest, broken-up meadows, and pasture-land, reclaimed peat-bogs, salt-marshes, and low-lying lands after they have been well drained. But even burned lime frequently does not develop its effects until the second or third year.

Quicklime can also act as a *decomposer* and *solvent* of mineral substances. It causes, for instance, an unlocking of the mineral constituents of the soil, the products of which (silica, potash, &c.) can then be consumed as food by the plants growing upon it. The experience that liming pre-eminently favors the formation of haulm, and gives the straw of the Cereals great stiffness, is explained by this in the most simple manner: It is not the lime which produces this, but the mineral substances rendered soluble and therefore assimilable by the lime above all the silica. The results of these experiments at the same time confirm the correctness of the opinion that the farmer need not pay any attention to silica in manuring, since it exists almost everywhere in sufficient quantity in the soil, but that he need only take care that there shall not be a deficiency of its *solvents,* and of the conditions which favor its solution. Thus, lime is a powerful means of assisting the oxygenation, or weathering, of stony and

earthy constituents of the soil; it, therefore, forms an aid to those bodies, and forces such as air, water, carbonic acid, (humus,) heat, &c., which carry on this process of decomposition everywhere in acting independently of human interference. In a heavy soil, this natural weathering can, of course, only proceed slowly, because the tenacity obstructs the access of air and the production of carbonic acid from humus. When, therefore, experience says that lime proves far more favorable in heavy than in light soils, it might certainly be deduced from the preceding statement, that its chemical action, now under consideration, may claim an essential share in the beneficial effects in the first case.

Lime forms a necessary constituent of all plants; if not present in sufficient quantity in the soil, the growth of vegetation is poor; therefore, lime may act favorably in certain cases by supplying this deficiency. By far the majority of soils contains lime abundantly sufficient for the requirements of the nutrition and development of plants; and, if manuring is performed regularly and properly, there can still less be a want of such kind, since stable manure, alone, conveys into the soil more lime than is removed from it even in very abundant crops; cultivated soils rather grow continually richer in lime, and plants, which consume very much lime in their development, especially if grown in frequent succession in the same field, will naturally lead much sooner to an exhaustion of the lime of the soil, than those plants which take up lime moderately.

Carbonate of lime is far less *coherent* in texture, and is of looser nature than clay or loam, so that it has the power of improving tenacious soils mechanically by rendering them less tough and solid; and hence, more porous and open. Quicklime changes into carbonate of lime by degrees in the soil, and will then consequently act in the same way. When mixed with sand, on the contrary, it renders this more coherent and close.

Lime also imparts to mixtures of earths, as is shown by saltpetre beds, the power of converting nitrogen, of putrefying and decaying vegetable and animal substances into nitric acid, which enters into combination with the lime to form nitrate of lime. According to some experiments made in England, lime is supposed to increase the power of earths to absorb ammonia from the atmosphere, and to contribute indirectly, by the decomposition of ammoniacal salts in the soil, to a fixation of ammonia by the clay and silica. Quicklime absorbs carbonic acid gas from the atmosphere and from the soil, passing in the operation into the mild condition of carbonate of lime. Possibly, this also may afford assistance to the growth of plants.

Lastly, it has been observed that the development of plants proceeds somewhat more rapidly in soils manured with lime, so that they run more quickly through the period from germination to maturity on unlimed land. Such an action upon the duration of vegetation would be a recommendation of lime for agriculture in northern, and elevated exposed districts.

Chalk.

Chalk is another form of carbonate of lime that occurs very abundantly in many countries, and which, from its soft, earthy nature, has been extensively applied to the land in many parts of England without burning. It is usually dug up from the pits, toward the close of autumn or beginning of winter, when full of water, and laid upon the land in heaps. During the winter's frost, the lumps of chalk fall to pieces, and are readily spread over the fields in spring. The quantity laid on varies with the quality of the soil, and of the chalk itself, and with the more or less perfect crumbling it undergoes during the season of winter, and with the purpose it is intended to serve. It gives tenacity and closeness to gravelly soils, opens and imparts freeness to stiff clays, and adds firmness to such as are of a sandy nature. If a physical improvement of this kind be required, it is laid on at the rate of from 400 to 1,000 bushels to an acre. But some chalks contain much more clay than others, and are employed, therefore, in smaller proportions. For the improvement of coarse, sour, marshy pasture, it is applied at the rate of from 150 to 250 bushels to an acre, and speedily brings up a sweet and delicate herbage. It is also said to root out sorrel from lands which are infested with this plant. These effects are precisely such as usually follow from the application of marl, and, like marl, the repetition of chalk exhausts the land, if manure be not afterward added to it in sufficient quantity.

Application of Lime to Land.—It has already been observed that lime, from its nature, must act both as a stimulant and as a manure, while it makes the earth exert itself in the nourishment of vegetables, in some measure, enriches it, and adds to the vegetable food. In some lands, the dissolving of the vegetable food, and fitting it for entering the rootlets of plants, may be most beneficial. In others, the communication of the power of attracting the vegetable food from the air may have an equally good effect. It will not be improper, therefore, to point out how lime is to be *applied*, so that it may chiefly answer one or the other of these purposes.

In uncultivated land, in which there is a large quantity of vegetable remains, lime ought to be used chiefly as a stimulus; and when improved land needs a recruit of vegetable food, it ought chiefly to be used as a manure. When thus intended as a stimulus, a large quantity should be applied at once, in an unslaked or half-slaked state; for it takes a considerable quantity to dissolve rootlets, and other vegetable substances in the soil, and to produce the necessary degree of fermentation. When intended as a manure, a small quantity applied at a time is sufficient. It is probable that it requires only a small quantity of lime to impregnate a large quantity of earth, and communicate to it an absorbent quality in as high a degree as it is capable of receiving; and it is certain that it is in proportion to the absorbent power which it communicates, that the soil is

enriched by it. This is not mere conjecture. It is certain that a small quantity of lime will impregnate a large quantity of water, and communicate to it all its virtues, and these in as high a degree, too, as it is capable of receiving.

The benefit to be derived from lime greatly depends, however, upon the nature and the state of the soil. Strong lands are much improved, for two or three crops, by this stimulant; but frequent repetition will not have the same good effect, unless the land in the interim has been placed under a clover or other green crop, by which vegetable matter will be introduced for the lime to act upon.

The deficiency of vegetable matter in light soils is one reason why lime does not always act upon them beneficially; and it should therefore be used very sparingly on these soils, with an interval of six or seven years between each liming. Indeed, it is often as necessary to change the mode of manuring land, as it is to change the crops to be cultivated; and it is from not sufficiently attending to this, that arable farms have become deteriorated, whilst the farmer fancied that he was doing great justice to the land by liming every third or fourth year. But let the introduction of a green crop be tried in such a case, and he will afterward find that his grain-crops increase, and his land is in better heart.

Some persons think, from witnessing its first effects, that they can always have recourse to lime with the same success; but in this, they will assuredly be disappointed; once in five, six, or seven years, according to the nature of the land, is as often as lime can be applied with advantage.

It may be proper to observe, likewise, that, when lime is applied in small quantities, as a manure, it is necessary to repeat the application frequently; it is probable that the soil loses its absorbent property communicated by the lime; for experience proves that, if lime be frequently used, it must be applied as a manure, and not simply as a stimulant; and to this end, it must be compounded with earth, clay, and other matter, to which it communicates its stimulating qualities, whilst its fertilizing effects are thereby augmented. In this state, it will act powerfully as a manure, and be a valuable auxiliary in the hands of the farmer.

Most varieties of subsoil strata make good compounds with lime. Sand and lime, with peat or turf, if it can be obtained, should be mixed for a clayey soil; and subsoil clay and lime, for sands, gravels, loams, and peaty lands. No farmer need complain of want of materials to make fertilizing compounds, since every sort of soil may be used for this purpose; and not only is immediate fertility produced thereby, but there are few districts in the country, however barren, that may not be improved, or brought into a fertile state, by dressing with a well-proportioned mixture of earth, clay, sand, and lime. Care should be taken, however, to proportion the quantity of lime according as the land is light or heavy, cold or warm. Light soils have been hurt by too abundant application of lime; and while one part of lime to form six to ten parts of earth may do for light soils,

one part of lime to two, three, or more parts of earth, will be required for heavy soils.

The application of lime, alone, to land long under tillage, is often found not to be beneficial; but, if the same quantity had been applied in a compound state, with sand, turf, earth, clay, or vegetable mould, good effects would have resulted. On deep loams, lime may be applied in a caustic state, more frequently than to most other soils; but the testimony of experience is in favor of its being used in a compound state.

Quicklime has the effect of disengaging and setting free the ammonia from guano and from fermenting manures. It is prudent, therefore, and a safer practice to apply the lime a short time before or after such manures have been laid upon the land. Where the soil is moist, and abounds in vegetable matter, there may not be much loss, should the lime and other manures come in contact beneath its surface; but in dry soils, and on the surface of the land, the admixture of the two ought to be carefully avoided. After the lime has been some time in or on the surface of the soil, and converted into a mild state, it can exercise no injurious effect upon any kind of manure.

The most valuable variety of lime for agricultural purposes is that obtained by burning oyster-shells, and allowing it to remain exposed to the air a few hours to slack. Quarry lime is not so good on account of the magnesia which it often contains, and from its small quantity or total want of phosphoric acid. The quantity used must depend upon the nature of the soil and the moisture, heat, or cold, of the climate; for, whilst 80 bushels to the acre are sufficient for sandy soils, loams will require 100, and clay 150 bushels. Again, in a hot sun, like that experienced in most parts of the United States, the quantity should not be more than half as much as in Great Britain, where the climate is cloudy, cool, and moist. It must be regularly spread, and lightly covered immediately with a plough, or harrowed in with the seed, but not too deeply, for lime, as a general rule, should be kept near the surface.

Those unaccustomed to the application of lime or charcoal to land, by sowing or spreading them upon the surface, are often at a loss to know how thick a coat to put on in order to dispose of a certain number of bushels to an acre. Therefore, I show at a glance, in the following table, the depth, to the nearest thousandth part of an inch, a given number of bushels will cover an acre of ground, assuming the bushels to contain $2{,}150\frac{42}{100}$ cubic inches; also, the number of bushels necessary to cover an acre of land to a required depth. For example, if there be 300 bushels spread to an acre, the depth will be $\frac{103}{1000}$ of an inch. If the depth be one inch, it will require $2{,}916\frac{937}{1000}$ bushels to cover the surface of an acre an inch deep:—

Bushels per acre.	Depth. Inch. Decimals.	Depth. Inch. Decimals.	Quantity per acre. Bushels. Decimals.
20	0.007	1.0	2,916.937
30	0.010	0.9	2,625.243
40	0.014	0.8	2,333.550
50	0.017	0.7	2,041.856
60	0.021	0.6	1,750.162
70	0.024	0.5	1,458.469
80	0.027	0.4	1,166.775
90	0.031	0.3	875.081
100	0.034	0.2	583.387
200	0.069	0.1	291.694
300	0.103	0.½	145.847

Crushed limestone has often been applied to the soil with success in the crude or unburned state; but its effects are slow and more lasting than lime that has been burned. It has not the solvent activity of quicklime, however, nor the absorbing power of chalk; nor has it the minute division of mild lime mixed with earth, while in an impalpable powder.

In a district where fuel is scarce, and limestone, or marble, plentiful, it might be cheaply crushed into a powder by means of water, steam, or animal power, and thus be economically prepared for improving most kinds of soil which are deficient in lime. But no lands in which calcareous mattĕr naturally abounds, nor those containing a large proportion of imperfectly-decomposed vegetable remains, such as bog roots, moss, &c., can receive much if any immediate benefit by the use of unburned lime, unless it be to render clayey soils mechanically lighter and boggy ones more firm.

The benefits derived from burning lime for agricultural purposes are partly chemical and partly mechanical; for, while in a caustic state, it acts more promptly in producing those chemical changes, which follow from mixing it with the soil. Even in the half-caustic state of spontaneously-slacked lime, its effects are more rapid and more quickly seen, than when it is entirely in a carbonate or unburned state. But the principal benefits arise from the minute state of division into which the lime is brought by burning and slacking. When the burned limestone is slacked, if it is tolerably pure, the lime falls, or crumbles to a powder—finer, probably, than any which could be produced by mere mechanical means—finer, certainly, than any to which the farmer could bring it, by any crushing machine he could afford to employ.

The chief advantages to be derived from this fine state of division of lime are, first, it may be diffused more equally and more perfectly through the soil, and thus go much further in improving it. Secondly, it more readily combines with acid substances in the soil,

and therefore sweetens it more readily and more quickly. And thirdly, it comes into closer contact with the organic substances in the soil, such as roots of grass, straw, leaves, &c., and consequently promotes more fully those chemical changes which are constantly going on in every fertile soil, to produce which, is one of the useful purposes for which lime is added to the land.

The above remarks are not intended to apply to such beds of impure limestone as may be employed for the manufacture of cements and hydraulic mortars; for these, when burned and ground to a powder, cannot be applied for the improvement of land in the usual way, without combining with the water or moisture in the soil, and shortly after become as hard as stone.

In countries abounding in limestone, there often exist scattered here and there, in the hollows and in the hill-sides, banks and heaps of sand and gravel, in which rounded particles of limestone are found. These are distinguished by the names of *limestone sand* and *gravel*, and are derived from the decay or wearing down of the limestone and other rocks by the action of water. Such accumulations are frequent in Ireland. They are indeed extensively diffused over the surface of that island, as we might expect in a country abounding so much in rocks of mountain limestone. In the neighborhood of peat-bogs, these sands and gravels are a real blessing. They are a ready, most useful, and largely-employed means of improvement, producing upon arable land the ordinary effects of liming, and, when spread upon boggy soils, alone, enabling them to grow sweet herbage, and afford a nourishing pasture. The proportion of carbonate of lime these sands and gravel contain is very variable. A sample of yellow sand, examined by Professor Johnston, contained 26 per cent. of carbonate of lime, the residue being a fine red sand, chiefly silicious; the other, a fine gravel of grey color, contained 40 per cent. of carbonate of lime in the form chiefly of rounded fragments of blue limestone, the residue consisting of particles of sandstone, quartz, and granite.

The application of these mixed sands to boggy land will not only consolidate and otherwise improve the physical character of the soil, but will greatly benefit its chemical composition. The fragments of granite, containing undecomposed feldspar and mica, will supply potash, and, perhaps, magnesia, to the growing plants, and will thus materially aid the fertilizing action on the limestone sand with which they are mixed.

Chloride of Calcium.

When common salt and slaked lime are mixed together, the salt is decomposed in whole or in part, and the soda of the salt is brought into the caustic state, while the lime is converted into *chloride of calcium*, a substance containing $63\frac{38}{100}$ per cent. of chlorine gas, very deliquescent, of a bitter taste, and dissolving in about one-fourth part of its weight of water at 60° F. The same substance may be obtained by dissolving chalk or quicklime in muriatic acid.

This solution occurs in sea-water, in the refuse of salt-pans, and is allowed to flow away in large quantities as a waste from certain chemical works.

The effects of this salt are well known as a promoter of vegetable growth, and it has been recommended that the waste of our salt-works and bleacheries be employed for fertilizing the land. But, as these wastes are not conveniently to be had in all parts of the country, it may be more economical to use common salt in connection with slaked lime. Both of these are very soluble in water, and can therefore readily act both upon the soil and upon the plant. Wherever common salt is useful as a manure, this mode of applying it in connection with lime may be safely recommended. It should be mixed with lime in such quantity as to allow from 100 to 300 pounds of salt to be laid upon each acre. The salt may be dissolved in water, and then thrown upon the lime, where it is the custom to slake with water; or sea-water alone may be employed instead of the salt for slaking the lime. A mixture of 600 pounds of quicklime with 200 pounds of common salt, it is stated, forms a powerful dressing for an acre of wheat, and also affords considerable benefit to the after-crops of clover and oats.

From some experiments made by M. Dubuc, of Rouen, in France, the effects of this salt were great upon potatoes, Indian corn, and on trees and shrubs of various kinds. He thinks that it would suit hemp, flax, and other oleaginous plants. Onions and poppies, manured with it, grew to double the usual size. From its liability to deliquesce, and consequent difficulty of transportation, he thinks that leached ashes, charcoal, and sawdust, or gypsum, should serve as the medium for spreading it on the land.

Chloride of Lime.

This salt, known also under the names of *oxymuriate of lime*, or *bleaching powder*, when dry, is of a pale, greyish-white color, and when of a good quality, should contain from 25 to 30 per cent., by weight, of chlorine gas. It is a compound of lime, in its slaked state, or as a hydrate and chlorine mechanically mixed; whereas the chloride of calcium, already described, is a perfect chemical compound, formed of chlorine and the metallic base of lime. Chloride of lime dissolves only partially in water, the solution of which, when exposed to the air, evolves chlorine, whilst the freed lime attracts carbonic acid, and forms an insoluble carbonate that collects in the bottom of the vessel. In a dry state, it likewise parts with its chlorine when exposed to heat, a change which also takes place when this salt is kept in a dark place.

As chlorine is not known to form a necessary constituent of vegetation, the effects of the chloride of lime have been much doubted by some, while others regard its virtues similar to those of gypsum in fixing the ammonia brought into the soil by rains and melted snows, and also as having a powerful influence on the germination

of seeds. It would seem to be highly important, however, that its favorable or neutral action upon the soil should be established; because, at present, large quantities of the residuum of many of our factories are thrown away, which otherwise might be used as a valuable manure. It is believed that on hot, sandy soils, if used in proper proportions, it would be productive of good results.

In the bleacheries of cotton, linen and woollen goods, paper-mills, &c., it is usually the practice to throw away the residuum of the stills or vats, as worthless articles; but, from various experiments made in Great Britain and elsewhere, it has been found that these substances, whether used in a liquid or dried state, possess considerable agricultural value. A portion of this lime refuse taken from the large waste heap of a bleachery, analyzed by Fromberg, after drying, consisted of

	Per cent.
Organic matter and a little water, - -	18.57
Sulphate of soda and sulphuret of sodium, -	14.23
Oxyd of iron and alumina, - - -	5.07
Carbonate of lime, - - - - - -	55.18
Silicious matter, - - - - - -	6.60
	99.65

Considering the large proportion of alkaline matter, as well as lime it contained, it is evident that it might be used with advantage in preparing land for green crops, or as a top-dressing for grass, and especially for clover. Mixed with a moderate quantity of night-soil, it serves as an excellent dressing for turnips.

Besides the lime refuse of bleacheries, there are considerable quantities of waste lyes, containing alkalies, as well as chloride and sulphate of lime, which daily run off, that would be valuable to the farmers in the vicinity, if collected in casks or manure-carts, and applied to young growing oats and other crops, as a liquid manure.

Gas–Lime.

The refuse lime of gas-works consists principally of a mixture of carbonate of lime, with a variable quantity of gypsum and other salts of lime containing sulphur, and a little coal-tar and free sulphur, the whole usually being slightly colored by Prussian blue, the chief difference of composition arising from the kind of coal employed in the manufacture of gas. The following table exhibits the composition of two gas-limes, as analyzed by Professor Johnston, one from Edinburgh Gas Works, and the other from those of London. The first two columns show what they contained when received from the works, and the second two, what they would have become after long exposure to the air, after being made into compost, or thoroughly incorporated in the soil:—

	Edinburgh.	London.	Edinburgh.	London.
Water and coal-tar, ...	12.91	9.59	12.91	9.51
Carbonate of lime, ...	69.04	58.88	67.39	56.41
Hydrate of lime, (caustic,) . .	2.49	5.92	....	....
Sulphate of lime, (gypsum,) .	7.33	2.77	16.45	29.32
Sulphite and hypo-sulphite of lime,	2.28	14.89	....	....
Sulphuret of calcium, . . .	0.20	0.36	....	....
Sulphur, ...	1.10	0.92	....	....
Prussian blue, ...	2.70	1.80	2.70	1.80
Alumina and oxyd of iron, .	....	3.40	....	3.40
Insoluble matter, (sand, &c.,) .	0.64	1.29	0.64	1.29
	98.69	99.82	100.09	101.81

The most marked difference between the two samples by the above analyses, is in the compounds called *sulphite* and *hypo-sulphite of lime*. The latter of these substances dissolves readily in water, and its presence in such widely-different proportions satisfactorily accounts for the very different effects which have followed from the application of gas-lime to the land in different districts in Great Britain. The rains dissolve the hypo-sulphite and the sulphuret, and carry them down in too great a quantity to the roots of young grain; and hence, the complaints of some that the gas-lime killed their wheat, while others found that, when applied as a top-dressing in a similar way, it greatly improved their crops. Therefore, unless the composition be satisfactorily ascertained, there will always be a degree of risk in applying it to the grain while the crop is growing.

Gas-lime, however, in no case, if possible, should be wasted, as it would appear that it may always be safely employed with good effects under the following circumstances:—

1. It may be used directly upon mossy land, upon naked fallows, and in spring, when preparing for turnips.

2. In composts, in which the whole of the soluble salts of lime will have a tendency to be converted into gypsum by the action of the air; and consequently the benefits which result from a large application of the same will be obtained by laying such composts upon the land.

3. As it appears usually to contain only a small proportion of caustic lime, it may with safety be mixed at once with barnyard or other animal manures, though not in too large a quantity. It may also prove a valuable admixture with guano, on which its action would ultimately be to fix, rather than expel, the ammonia.

4. Strewn sparingly over the young turnip-plants, it is stated that it prevents the attack of the turnip-fly; and harrowed in when the ground is naked, if the quantity be considerable, slugs and wire-worms disappear from its effects.

5. If applied in too large a quantity, it is liable to be injurious to crops of young grain. But grass-lands, though at first browned by its application, soon recover and repay the cost by yielding a greener and an earlier bite in spring.

Gas-lime, fresh from the works, it is also stated, is one of the best materials to lay under the floors of farm-buildings; for it not only serves to absorb and fix the fertilizing gases in such situations, and afterward will form a good manure, but, being excluded from the air, it retains its disagreeable smell for a long time, and is much disliked by vermin and rats.

Hydrate of Lime.

It has already been stated that, when quicklime is slaked, it combines with water which is added to it, and becomes converted into a milder or less caustic compound, known among chemists by the name of *hydrate of lime.* It is in this form, it may be well to repeat, that lime is usually applied to the soil. When pure, this hydrate consists of

	Per cent.
Lime, - - - - - - - -	76
Water, - - - - - - - -	24
	100

or, one ton of pure burned lime produces nearly 2,500 pounds of the slaked or hydrate. It is rare, however, that lime is sufficiently pure, or is so skillfully and perfectly slaked as to take up the whole of this proportion of water, or to increase quite as much as one-fourth part in weight.

When the hydrate of lime, obtained by slaking, is exposed to the open air, it gradually absorbs carbonic acid from the atmosphere, and tends to return to the state of a carbonate like that in which it existed before burning. By mere exposure to the air, however, it does not attain to this state within an assignable time. Thus, in a wall built by the Romans 1,800 years ago, it was found by analysis that the proportion absorbed had not exceeded 75 per cent., contained in natural limestone. In damp situations, the absorption of carbonic acid proceeds most slowly.

Nitrate of Lime.

When common chalk or limestone is dissolved in nitric acid, (aquafortis,) nitrate of lime is obtained in the solution. It contains of

	Per cent.
Lime, - - - - - - -	34.46
Nitric acid, - - - - - -	65.54
	100.00

This nitrate is often produced naturally in compost heaps to which lime has been added, and it is only in such compost heaps that it has hitherto been applied in any quantity to the soil. It is also found not unfrequently in the soil as well as in the rocky formations of the crust of our globe. The celebrated Mammoth Cave, in Kentucky, situated in a limestone ridge, yields an inexhaustible supply of nitrate of lime. During the late war with Great Britain, fifty men were constantly employed in lixiviating the earth of this cave, and in about three years, the washed earth is said to become as strongly impregnated as at first. Through the cave, a strong current of air is continually rushing, inward in winter, and outward during the summer months. On the plaster of old walls, too, especially in damp situations, an efflorescence of this and other nitrates is frequently observed over many parts of the globe. In China, according to Davis, the old plaster of the house is so much esteemed, as a manure, that parties will often purchase it at the expense of a coating of new plaster.

Nitrate of lime is very soluble in water, and is deliquescent. It is decomposed by fixed alkalies, potash forming therewith saltpetre, (nitrate of potash,) and soda, cubic nitre (nitrate of soda.) According to Dr. Home, it is contained in what is commonly called "hard" water, which, by his experiments, was found to promote the growth of plants in a much higher degree than soft water.

Oxalate of Lime.

The chemical salt called *oxalate of lime*, when pure, consists of a white powder, extremely insoluble in water, but soluble in muriatic and nitric acids. It is formed by the combination of calcareous matter with oxalic acid, and may be exposed to a heat of 560° F. without decomposition.

Oxalate of lime forms the principal solid parts of many lichens, especially of the *Parmelia cruciata* and the *Variolaria communis*, which contain as much of this salt as is equivalent to 15 or 20 per cent. of pure oxalic acid. A species of parmelia, collected after the droughts of the sands of Persia, contained 66 per cent. of the substance.

From the insolubility of oxalate of lime, it is not probable that it can contribute, by itself, to the food of plants. It cannot be decomposed by alkalies, on superior affinity, because its affinity is greater with calcareous matter; but it may be decomposed by sulphuric acid, in which gypsum will be found, and the oxalic acid, thus disengaged, will be capable of entering into new combinations with fixed or volatile salts or magnesia. These combinations are soluble, and when not super-acidulated, they promote vegetation in a high degree.

Phosphate of Lime.

Lime combines with phosphoric acid in variable proportions, and forms several compounds. Of these, by far the most abundant, and

certainly the most useful in agriculture, are the earthy parts of bones, and a native mineral, called *phosphorite*, both of which are hereafter described under their appropriate heads. And it occurs, but less abundantly, in corals, oyster-shells, and in the shells of other fish; in the teeth, horns, nails, hair, and other parts of animals; and in the horny wings and covering of numerous insect tribes. It also exists in minute quantities in nearly all limestones and marls; probably there are few fertile soils in which it is wholly wanting. It likewise forms one of the ingredients in the grain, straw, stalk, or roots of most cultivated crops; and hence, is indispensable to their perfect growth and maturity.

Bi-phosphate of Lime.

When burned bones are reduced to powder, and digested in sulphuric acid, (oil of vitriol,) diluted with once or twice its weight of water, the acid combines with a portion of the lime, and forms sulphate of lime, (gypsum,) while the remainder of the lime, and the whole of the phosphoric acid are dissolved. The solution, therefore, contains an acid phosphate of lime, or one in which the phosphoric acid exists in much larger quantity than in the earth of bones. The true bi-phosphate, when free from water, consists of

	Per cent.
Lime, - - - - - - -	28.5
Phosphoric acid, - - - - - -	71.5
	100.0

This substance exists in the urine of most animals, and is therefore an important constituent of liquid manures of animal origin. If the mixture of gypsum and acid phosphate, above described, be largely diluted with water, it will form a most valuable liquid manure, especially for grass-lands, and for crops of rising grain. In this liquid state, the phosphoric acid will diffuse itself easily and perfectly throughout the soil, and there will speedily lose its acid character and unite with one or other of the following substances, almost always present in every variety of land, namely, potash, soda, ammonia, lime, or magnesia, which have the property of combining with acids, and thus neutralizing them, or depriving them of their acid qualities and effects. Or, if to the solution, before it is applied to the land, a quantity of pearlash be added until it begin to turn milky, a mixture of the phosphates with the sulphates of lime and of potash will be obtained; or, if soda be added instead of potash; or, the phosphates with the sulphates of lime and of soda, either of which mixtures will be still more efficacious upon the land, than the solution of the acid phosphates alone. Or, to the solution of bones in the acid, the potash or soda may be added without further dilution, and the whole then dried up by the addition of charcoal powder, or even of vegetable mould, until it is in a sufficiently dry state to be scattered

with the hand as a top-dressing, or buried in the land by means of a drill.

Earth of Bones, or Bone-Earth.

These are names given to the white, earthy skeleton which remains when the bones of animals are burned in an open fire until everything combustible has disappeared, and then is united with an additional quantity of phosphoric acid. This earthy matter (bone-earth, or bone ash,) is composed chiefly of lime and phosphoric acid, which are combined in the following proportions:—

	Per cent.
Lime, - - - - - - - -	51.5
Phosphoric acid, - - - - - -	48.5
	100.0

Native Phosphate of Lime.

Another rich phosphate also occurs abundantly in Nature both in masses and in veins, when it is known by the names of *apatite*, or *phosphorite*. It occurs somewhat abundantly in various parts of the world, and is composed chiefly of phosphate of lime, which differs but slightly in its chemical constituents from the earth of bones. When pure, it consists of

	Per cent.
Lime, - - - - - - - -	54.5
Phosphoric acid, - - - - - -	45.5
	100.0

From the composition of this mineral, one would be led to expect that it would exert a favorable action on vegetation, which has been amply verified by experiments made by Sprengel, of Germany, and particularly by Dr. Daubeny, professor of chemistry at Oxford, in England. From the reputed existence of an extensive bed of phosphorite near Logrosan, in the Province of Estremadura, in Spain, the last-named gentleman was commissioned to examine the mine, in 1843, by the Royal Agricultural Society of England, to ascertain whether the mineral could not be profitably imported into that country as a substitute for bones, as a manure. The result was, that the expense of freight, inland transportation, and other charges would be too great to warrant the undertaking. He found that it existed in a bed, or vein, 6 or 7 feet thick, of unknown depth, and occurred in one entire white, radiating, silky mass. He was allowed to dig and carry away any quantity he liked, and accordingly obtained four mule-loads of about 200 pounds each, which he took to England and made carefully-conducted experiments with it in comparison with twelve other fertilizers. The result of these experiments may be found in the London Agricultural Gazette of April 4th,

1846, in which it will be seen that a given quantity of the phosphorite grew nearly as large crops of turnips and grass as the amount of bone-manure; and Dr. Daubeny now says, as the Spanish phosphorite, which appears to act so beneficially, is wholly destitute of organic matter, it seems to follow that the more valuable portion, (and at least of what is applied to the land,) when bones are scattered over it, is the phosphate of lime, and not, as some have supposed, the oil or gelatin. He found 81 per cent. of this phosphate in the substance, which he estimates to be equivalent to almost 76 per cent. of the earth of bones.

From more recent discoveries, it has been ascertained that this mineral exists in great abundance in some parts of the United States, and is thought by some, will supersede the use of bones, both on account of its cheapness, and the facility with which it can be made applicable for the purposes of manure. At Crown Point, Lake Champlain, Essex county, New York, a mine was opened by Professor E. Emmons, of Albany, in 1850, which turned out to be a solid vein of phosphorite, 8 feet thick, containing 92 per cent. of phosphate of lime, associated with fluorine, chlorine, and the sulphurets of copper and of iron.

In the summer of the same year as above, Dr. Charles T. Jackson and Mr. Francis Alger, of Boston, discovered a valuable and extensive deposit of massive phosphorite near or at Hurdstown, Morris county, New Jersey, and but a few miles from the Morris Canal. The mineral is reputed to be perfectly pure, parcels of which were distributed in various parts of the country as well as in England, for the purpose of experiment. In the neighborhood of the same locality, just within the confines of Sussex county, the New Jersey Mining and Exploring Company opened the same or another vein of this substance, having, it is stated, a thickness of 8 feet, extending more than two miles in length, from which it is believed an unlimited quantity of this phosphate can be supplied.

This substance may be ground to a powder and spread upon old grass-lands, or dissolved in dilute sulphuric acid, and applied to grain and turnip-crops, at the rate of 1,000 to 1,200 pounds to the acre; but, owing to its admixture with the rocks in which it occurs, it is necessary to analyze each parcel of the ground mineral, to ascertain the proportion of acid that is required for its decomposition. In this state, when pure, it consists of

	Per cent.
Lime, - - - - - - -	54.5
Phosphoric acid, - - - - - -	45.5
	100.0

Phosphate of lime is decomposed by carbonic acid, as may be proved by the following fact: A gallon of carbonic acid water will dissolve 30 grains of bone-earth out of any given quantity acted upon. In this case, the carbonic acid not only drives off a portion of the phosphoric acid found in solution, and takes its place in union with the

lime, but its affinity for lime, assisted by the existing affinity of bone-earth for phosphoric acid, induces such an interchange of elements, (one portion of bone-earth being decomposed, its lime uniting with carbonic acid, and its phosphoric acid uniting with the phosphate of lime in another,) that the resulting compounds are a *super-phosphate of lime*, which is soluble in water, and a carbonate of lime, that is found among the sediment. Hence, it is from its solubility in carbonic acid, and of certain other organic acids which exist in the soil, that, by means of these acids of phosphate of lime, it is supposed to be rendered capable of entering into the rootlets of plants. Wherever vegetable matter exists, and is undergoing decay in the soil, the water makes its way to the roots more or less laden with carbonic acid, and thus is enabled to bear along with it not only common carbonate of lime, as has already been shown, but also such a portion of phosphate as may aid in supplying this necessary food to the growing plant.

Silicates of Lime.

These compounds vary in their compositions, but, when pure, consist of

	Per cent.
Silicic acid, - - - - - -	61.85
Lime, - - - - - - -	38.15
	100.00

They may be formed by a mixture of silicious sand or flint with quicklime, which readily melts into a glassy silicate, or a mixture of two or more silicates of lime. These silicates are also present in large quantity in window and plate-glass, and in some of the crystalline rocks (granite and trap.) In feldspar and mica, which abound in the alkaline silicates, it is rare that any lime can be detected. In that variety of granite, however, to which the name of Syenite is given by mineralogists, hornblende takes the place of mica, and some varieties of this hornblende contain from 20 to 35 per cent. of silicate of lime. This silicate is almost always present in the basaltic and trap-rocks, and sometimes, as in the augitic traps, in a proportion much larger than that in which it exists in the unmixed hornblende. Silicates of lime are also found in the ash, and probably exist in the living stem and leaves of plants.

Like the similar compounds of potash and soda, the silicates of lime are slowly decomposed by the united agency of the moisture and the carbonic acid of the atmosphere. Corbonate of lime is formed, and silica is set at liberty. This carbonate of lime dissolves in the rains or dews which descend loaded with carbonic acid; and the same waters take up also a portion of the soluble silica, and diffuse both substances uniformly through the soil in which the decomposition takes place, or bear them from the higher grounds to the rivers and plains. The sparing, but constant and long-continued supply of

lime thus afforded to soils which rest upon decayed trap, or which are wholly made up of rotten rock, has a material influence upon their well-known agricultural capabilities.

In those districts where the smelting of iron is carried on, the first slag which is obtained consists in great part of silicate of lime. This slag accumulates in large quantities, and is not unworthy the attention of the practical farmer, as an improver of his fields, especially where caustic lime is distant or expensive, or where boggy and peaty soils are met with, in which vegetable matter abounds. On such land, it may be laid in large quantity. It will decompose slowly, and, while it imparts to the soil solidity and firmness, it will supply both lime and silica to the growing crops for a long period of time.

Gypsum, or Sulphate of Lime.

Gypsum, or sulphate of lime, is a well-known, white, crystalline compound found abundantly in large deposits in numerous parts of the globe. It is present in many soils, particularly in peat, and is detected in sensible proportions in lucern, sainfoin, ray-grass, red clover, and turnips, as well as in the dung of most, if not all, animals subsisting on grass. It is found, as a natural production, under the names of anhydrite, (which occurs in rocky masses almost free from water,) selenite, and alabaster. The native plaster, or gypsum of commerce, consists of

	Per cent.
Water,	21
Lime,	33
Sulphuric acid,	46
	100

But when calcined, it consists of 41½ per cent. of lime, and 58½ of sulphuric acid. Deprived of its water, at a low, red heat, it forms the well-known "plaster of Paris," which, when made into a thin paste with water, chemically unites with it, and forms, in a few minutes, a hard substance, as in plaster casts, or moulds, cornices in rooms, &c. It is soluble in 450 parts of boiling water, or in 500 parts of cold water; owing to which circumstances it is often found in springs. A ton of pure gypsum, when crushed, will yield about 25 bushels.

The use of plaster in agriculture, as such, is not old, although it was doubtless used by the Roman farmers, and early inhabitants of Britain, as well as by the Lombards. It was not much applied in modern times until some years after its first discovery as a manure by Mr. Meyer, a clergyman of Germany, in 1768. Its use spread after this date in that country, and penetrated France, Switzerland, Great Britain, and the United States, where it has been successfully employed, without interruption, in the vicinity of Philadelphia, and elsewhere, ever since the year 1772. And it may be worthy of

repeating that, when Dr. Franklin wished to introduce the use of this fertilizer into America, in order to convince his countrymen of its efficacy, he sowed in large letters, upon a clover-field, in the city of Washington, in powdered gypsum, the following phrase: "THIS HAS BEEN PLASTERED."

Theoretically, gypsum attracts ammonia from the atmosphere, and retains it for use of vegetation. Its action, as a manure, is two-fold: In the first place, it serves directly for the food of several cultivated plants; and secondly, it fixes and retains certain soluble substances in the soil, which are necessary to their growth and nutrition. Nor is this all. To the same property is to be ascribed its action of fixing ammonia, when scattered over stable floors, dung-hills, manure-tanks, &c., by absorbing it and therefore preventing its escape. By "fixing," is meant the formation of sulphate of ammonia, from its carbonate. Rain-water, for instance, is supposed to bring down with it carbonate of ammonia, which acts upon gypsum in such a way as to abstract its sulphuric acid, and form *sulphate of ammonia*, and exchange therefore its carbonic acid, converting the gypsum into *carbonate of lime*. Thus, the carbonate of ammonia, which is brought down by the rain, if it does not meet with sulphuric acid in the soil, readily becomes volatile and rises again into the air; whereas, the contrary is the effect with sulphate of ammonia, and hence the meaning of the term "fix." Supposing the gypsum to meet with a sufficient supply of ammonia in the soil, and that it exercises its full influence, 100 pounds of common *unburned* gypsum will fix or form sulphate with nearly 20 pounds of ammonia, containing 16½ pounds of nitrogen. One hundred weight, therefore, (112 pounds,) will form as much sulphate as will contain 22½ pounds of ammonia; and, if introduced without loss into the plants, it will furnish them with 18½ pounds of nitrogen.

The sulphuric acid contained in gypsum, from well-known principles, also acts beneficially in decomposing and bringing into activity the humus and insoluble matter accumulated in loams or peaty soils. Gypsum is decomposed by carbonate and muriate of barytes, the carbonates of strontia, potash, soda, and of ammonia, as well as by oxalic and humic acids, and where any of the four last-named occur naturally in the soil, or are applied by artificial means, new combinations take place, which are attended in some cases with beneficial results. For instance, in order that gypsum may be useful as a fertilizer, the soil must always contain more or less humus, even if it be only 2 or 3 per cent. If, however, it contains too much free humic acid, it will decompose the gypsum, so that humate of lime will be formed, and the sulphuric acid will be set free, which may then act as a corrosive on the rootlets of the crops. On this account, a soil very rich in humus must never be manured with too much gypsum, because, though the sulphuric acid were to combine with another base contained in the soil, it would still form therewith a salt easily soluble in water, by which the plants would receive too much sulphuric acid at once. If strewn over fresh dung, and ploughed in with it in the field, it will undergo a partial decomposition by the

carbonate of ammonia developed from the excrements, so much so, that sulphate of ammonia and carbonate of lime are formed. Gypsum, therefore, is known to act chiefly through its sulphuric acid, which, on the one hand, obtains soluble ammonia from the humus constituents of the soil, and furnishes this to the plants at a period when they are especially inclined to the production of leaves and stems; and on the other hand, strengthens and increases the power of plants to absorb ammonia from the atmosphere, and this in greater proportion as these are more abundantly endowed with delicate and juicy leaves, and are thus already fitted by Nature to make a more abundant use of the atmosphere.

Some difference of opinion appears to exist among agriculturists whether gypsum should be used in a crude state or burned; but experience proves that the *effects are the same, whether calcined or rough.* In a raw state, when reduced to powder, it does not swell in water, but remains like sand. But when roasted, or rather heated at a temperature just below redness, and diluted with its bulk of water, it will harden, or *set*, at the end of five or ten minutes; then, if we dilute it with another equal dose of water, and as soon as the mixture begins to harden again, we add a third dose of water of equal bulk, and proceed thus five or six times, the mixture will still acquire a weaker consistence. Then, if divided into clods, and left to dry in the air, it can easily be reduced to a fine powder. In this condition, plaster acts so much the better, as it presents more surface to the influence of water, and is the sooner dissolved, and taken up by the roots of plants. Indeed, it appears that its swelling, at each addition of water, generally increases its bulk; and consequently its particles are more and more divided, till they occupy five or six times their former volume, by the agency of water. On the contrary, when we employ plaster which is too much roasted, it does not even absorb a volume of water equal to itself, nor does it expand, nor undergo any further division, in consequence of which it does not retain scarcely one-sixth part as much interposed water as the well-roasted plaster, and therefore presents so much the less hold for the dissolving action. Hence, the only use of roasting plaster for agriculture consists in the minute and easy division which results from the calcination; and it is easy to perceive how important it is to avoid the excess of temperature which produces the contrary effect.

By burning, gypsum loses nothing but the water of crystallization, or the water chemically bound up, as the sulphuric acid contained in it cannot be expelled even by the most violent heat of the furnace. Therefore, it is distinguished from unburned gypsum merely by no longer containing water, and hence it is about one-fifth stronger. If left in the air, it will attract from it as much water as it had previously lost by burning, which again becomes chemically fixed, but does not sensibly deteriorate in its value as a manure. Hence, it does not acquire new characteristic properties through burning, like lime, which, as is well known, becomes sharp, caustic, and alkaline.

From its property of being rather soluble in water, gypsum generally passes into the plants in an entire state. In its application, it

is frequently strewn over the young growing crops; and farmers like it still better, if the plants are yet wet from dew, as it will then act as a better stimulus upon the leaves. Still, experience has shown that it will produce the same effect, if it is washed off the leaves by rain water; nay, it has been found, in most cases, it will improve the growth of clover best, if it be strewn over the field before winter, and harrowed in with the seed. This phenomenon is easily explained by the gypsum sooner finding in the soil the water required for its solution; and, it being now distributed over the whole furrow-slice, it can easier be received by the roots of the plants. The favorable issue of manuring with gypsum depends yet on another circumstance. It will act beneficially only in wet, warm seasons, as in this case the water will not only convey it to the plants, but the heat will assist the assimilation of the sulphuric acid contained in it; that is, the leaves will only deoxydize the sulphuric acid by the assistance of the solar rays whereby they exhale the oxygen and retain sulphur for the formation of albumen, gluten, &c. That this process actually takes place in leaves, is to be seen by the gypsum acting very little in dark, wet weather, and that, being strewn over clover, growing in the shade, it will not exert any influence upon it at all.

Gypsum, like lime and marl, requires to be applied with discretion, and alternately with other manures. Without attention in this respect, it will not always succeed. It has generally been found more useful when applied to clover, lucern, sainfoin, beans, peas, vetches, and several of the grasses, than in the cultivation of grain, turnips, and other green crops. In France, its effects have been extolled, when applied to the roots of orange-trees, the olive, mulberries, and the vine. In America, it is employed with success in the cultivation of Indian corn, buckwheat, and rye; and in some instances it has given much activity to the growth of hemp.

The soils upon which gypsum operates most beneficially are those that are light, dry, and sandy, or open, as they soonest admit the rain-water, which dissolves and conveys it to the roots of the plants; whereas, clayey soils, which are stiff and impervious to the rains, retain the plaster for a greater length of time. In some cases, gypsum will not produce any effect, on account of the soil already containing sufficient sulphate of lime, or being deficient in one or more substances required for the growth of plants; for, in order that such a simple substance as gypsum may act beneficially, the soil must possess all the other substances requisite for the crop. Thus, in a plant, like red clover, which requires fourteen or fifteen substances to perfect its growth, if only one of these simple substances be deficient, potash, for instance, it is clear that the remaining thirteen or fourteen would be of little or no avail, however abundant any of the others may be; for plants require only a determinate quantity of food, and an excess may be detrimental and do no good.

Gypsum being itself calcareous, it would seem to follow that it should not be employed on land containing much lime; but experience has proved that it may be advantageously applied to chalky, and limestone soils, and particularly those which have shortly before been

enriched with marl. On land which has been exhausted by cropping, and which contains not much vegetable matter, it will prove of little or no avail; but it will do good after an application of barnyard dung, or after ploughing under a green crop. Plaster is sometimes used upon dry meadows, in which leguminous grasses predominate, and consequently increase their forage; but its application must be alternated with animal manure; otherwise the fertility which it produces will not be sustained, and in a few years of repeated plastering, the product will descend lower than before. Therefore, gypsum should not be too often repeated upon the same soil, especially if it is moderately or very rich, as most soils generally require a change in manures, as well as in crops, once in every five or six years.

Plaster may be applied to grass-lands by scattering it broad-cast over the surface or over cultivated ground, harrowing it in at the time of sowing the seed. It may also be applied in the hill at the time of planting beans, peas, or Indian corn ; or it may be applied to the plants of these crops at their first or second hoeing. For grass-lands, it is recommended to sow it in the spring, even when the grass is 5 or 6 inches in height ; and when sown in August, after harvest, upon clover leas, a fine aftermath may be cut, and the crops of the year following will experience nearly the whole of its good effects.

The best time for applying plaster is in the evening or morning upon the dew, or in calm and cloudy weather, just before or after a slight rain; for, if the weather be very rainy, its effects will be lessened, if not altogether destroyed. When sown with grain, its ordinary dose is equal in bulk to that of the seed, say 200 or 300 pounds to an acre ; but to grass-lands, or crops of legumes, potatoes, and Indian corn, 5 or 6 bushels to the acre are commonly employed. Used in a compost of earth or dung, or combined with other manures, such as guano, rape-dust, &c., it has been applied to turnips with marked effect. If a little gypsum be strewn over barnyard dung, while being turned over before using, its activity is very much increased.

MARL.

By the term "marl" is generally understood an earthy mixture usually containing not less than one-fifth part of its weight, or 20 per cent. of the carbonate of lime. If the proportion of lime be less than this, the compound is a marly clay or soil rather than a true calcareous marl. When a piece of stiff or tenacious marl is put into water, it usually loses its coherence, and gradually falls to powder. This is a very simple method of distinguishing between a true marl and a stiff clay. Marl, again, may be said to be a "lime-mud" deposited in low situations in the last overflowings which have taken

place on the surface of the globe, sometimes occurring tolerably pure, and at others, more or less intermingled with clay, loam, stone, shells, &c. In particular, rare cases, however, it has been produced from limestones, or rocks containing much lime, which the influence of the weather has changed into an earthy mass, or at least so far decomposed that they fall into this condition when laid open to the air, especially when frost assists the action. In this substance, lime is contained in a state of carbonate, the quantity of which sometimes amounts to 70 or 80 per cent. The kinds richest in lime are called *lime* or *chalk-marl;* those composed of clay and lime, *clay-marl;* those consisting of loam and lime, *loam-marl;* and those of sand and lime, *sandy marl.* When quicklime is allowed to lie long exposed to the air, it gradually reabsorbs from the latter the carbonic acid which had been driven off by burning, and becomes again carbonate of lime, which, however, is distinguished from the original by its finely-divided pulverulent consistence. In this condition, it may be regarded as an exceedingly rich lime-marl. The same thing takes place, and usually much more rapidly, in the soil, and hence, after a longer or shorter period, after a manuring with lime, we must look for the latter in the soil in the condition of marl or carbonate of lime.

Marls, again, are of various colors, white, grey, yellow, blue; and of various degrees of coherence, some occurring in the form of a more or less fine, loose, sandy powder. These differences arise in part from the kind and proportion of the earthy matters they contain, and in part, also, from the nature of the locality, moist or dry, in which they are found. They vary also in their composition. Some rich marls consist in part or in whole of broken and comminuted shells, which clearly indicate the source of the calcareous matter they contain. The clay and stone-marls are very similar in their composition; but the shell-marl is very different from the other two, which renders it necessary to treat of each under separate heads.

Clay–Marls.

These have the appearance of a more or less tenacious clay. When long exposed to the air, or put into water, they crumble into powder. They seem to have much the same qualities of lime; and therefore must operate in a similar manner when applied to the soil, by enlarging the pasture of the plants, and fitting the vegetable food for entering their rootlets. These marls also communicate to the soil a power of attracting vegetable food from the atmosphere. Clay-marls usually contain from 68 to 80 per cent. of clay, and from 20 to 32 per cent. of calcareous matter, silicious sand, &c.

Stony Marls.

These are often richer in lime than those which are clayey. The chief difference between them is this: The clay-marls are sooner dissolved than the stone-marls, and commonly have a stronger power of neutralizing acids and producing salts. As they are longer in

dissolving, large pieces of stone-marl are sometimes seen in lumps, or clods, six or seven years after they have been laid upon the land. This renders it necessary to apply a very large quantity.

Clayey and stony marls are well suited to light sandy soils, which they improve and render more solid. On the contrary, sandy marl is good for stiff soils, causing them to be friable and more easy to work.

SHELL-MARL.

This marl is very different in its nature from the two just described, being highly fertilizing upon soils of every description. It does not dissolve, however, with water like them, but sucks it up, and swells with it like a sponge. It is stated that it is a much stronger attractor of acids, and requires six times the quantity to become saturated. From this circumstance, if it be applied in a large quantity, and frequently repeated, it is possible that it might communicate such an attractive power to the soil as to enrich it in a very high degree.

As this kind of marl does not deprive land of its vegetable matter like lime nor the other varieties of marl, it may be applied to soils exhausted by them, or it may be repeated. It dissolves sooner than the other kinds, and consequently its effects are more sudden; and as it does not dissolve so readily as dung, its influence will sooner be over. Its effects, however, are not so quick as those of lime, but are more lasting.

As calcareous marl operates in a similar manner as lime, it follows, likewise, that limed land, exhausted by crops, can receive but little benefit from its application; and that marled land, exhausted by cultivation, can receive but little benefit from the application of lime. As it exhausts the vegetable food, the proper manure after it, is a muck compost with dung, which contains this food in the greatest abundance. What is said of lime, also, with respect to its application in smaller and larger doses, may likewise be said of marl. When light, barren land is to be improved, the marl should be laid on in large quantities, say from 1,000 to 2,000 bushels to an acre; but when the soil is in good condition, one-fifth or one-sixth part of the quantity, if applied once in six or seven years, will be attended with good results.

CORAL AND CORAL-SAND.

"Coral" is a general name for those marine polypifers which have stony or horny axes. It is of various colors, and is composed principally of carbonate of lime, assuming sometimes the character of trees or shrubs, and at other times a round form. Corals are the solid secretions of zoophytes, produced within the tissues of polyps, and corresponding to the skeleton in the higher order of animals. The surface is usually covered with radiated cells, each of which marks the position of one of the polyps; and when alive, these polyps appear like flowers over every part of the zoophyte.

Coral-sand, which is similar in its nature to coral itself, has been freely used in France as a manure in the same way and with similar effects as marl. It is preferred by the farmers in a fresh state, probably, because it contains both more saline as well as more animal matter than after it has been exposed for some time to the air. Payen and Boussingault, it will be remembered, ascribe the relative manuring powers of different substances when applied to land to the quantity of ammonia or nitrogen, which they severally contain, and thus, compared with farmyard manure, attribute to coral-sand the following relative values:—

	Per cent.
100 pounds of farmyard manure contain of nitrogen, - - - - - - -	40
100 pounds of coral-sand, (merl,) - - -	.51

That is to say, so far as the action of these substances is dependent upon the nitrogen they contain, fresh coral-sand is about one-third more valuable than an equal weight of farmyard manure.

A sample of fine infusorial sand, which is highly prized by the local farmers on the coast of Normandy, as analyzed by Professor Johnston, consisted of the following ingredients:—

	Per cent.
Organic matter, - - - - - -	5.06
Chloride of sodium, (common salt,) - -	1.01
Gypsum, (plaster,) - - - - -	0.32
Chloride of calcium, - - - - -	0.73
Magnesia, - - - - - -	trace.
Carbonate of lime, - - - - - -	43.50
Alumina, - - - - - -	0.17
Oxyd of iron, - - - - - -	1.20
Oxyd of manganese, - - - - -	trace.
Insoluble silicious matter, - - - -	47.69
	99.68

From this analysis, Professor Johnston thinks that the value of this mealy sand does not depend solely upon the lime ($43\frac{1}{2}$ per cent.) it contains, but is derived in some measure, also, from the 5 per cent. of organic matter, and the 2 per cent. of soluble salts, which are present in it. It is remarkable, also, for containing nearly half its weight (48 per cent.) of silicious matter in the state of an exceedingly fine powder. Its value, therefore, over the coarser shell-sand, consists in its organic matter and soluble salts, and in the minute state of division in which its particles are found. This fine powdery state enables it to be mixed more minutely with a clayey soil; causes an equal weight to go further; and prevents it from opening and rendering still lighter the more sandy soils, in the manner coarse fragments of shells would be apt to do. In Normandy, it is gener-

ally applied in the form of compost, and is extensively mixed with farmyard manure, which it is said greatly to improve.

It is well known that the reefs and shoals of the Keys of Florida, as well as of the Bahama Islands, in many places, are composed entirely of broken or comminuted coral-shells, infusoria, &c., the supply of which is inexhaustible, and would subserve the purpose of manuring all the cultivated lands in the Atlantic States, for thousands of years. The cost of procuring this sand, and delivering it at any of our sea-ports, south of Boston or New York, would probably not exceed $3 or $4 a hundred bushels, and if it were brought here as ballast from Key West, or Nassau, New Providence, it could be afforded for much less. This is a subject worthy of investigation, and experiments might be tried on a limited scale, by our agriculturists, both at the North and South.

Coprolites.

These fossils, which usually occur of a conical shape, are generally found in the ancient calcareous formations, and are shown by Dr. Buckland, in his "Bridgewater Treatise," to be the petrified excrements of extinct animals. They are also represented to be found in the State of Maine, and occur in numerous limestone formations in other parts of the United States. They are most frequently found in layers of rocks, and are generally associated with other fossils of various compositions, forms, and textures. Sometimes, however, they occur, as water-worn pebbles, coarse gravel, or in a more comminuted state in the soil. An analysis of a sample made by Herepath gives of

	Per cent.
Phosphate of lime, magnesia, and iron,	53.7
Carbonate of lime,	28.4
Sulphate of lime, (gypsum,)	0.7
Silica,	13.2
Water,	3.4
	99.4

Besides the other ingredients, the above analysis indicates that there is an equivalent of 26⅗ per cent. of phosphoric acid, which shows coprolites are an invaluable manure. They are about as rich in phosphate and carbonate of lime, as the recent bones of an ox, when perfectly dried, and deprived of their fat. The latter yield of phosphate of lime 56¾ per cent., and of phosphate of magnesia 3¼ per cent., which is equivalent to 26$\frac{7}{10}$ per cent. of phosphoric acid. It is to be observed, however, that coprolites, in general, are intensely hard, so much so, that it requires powerful machinery to grind them; and that, even when reduced to powder, they are not sufficiently soluble of themselves for direct application to the soil. They are readily dissolved by sulphuric acid, and then afford a most excellent manure for turnips, cabbage, rape, &c.

MAGNESIA.

Magnesia, the prot-oxyd of magnesium, when pure, is a very light, white, odorless, tasteless powder, occurring abundantly in Nature, particularly in combination with lime, in the form of a carbonate, and in soap-stone, and serpentine in the form of silicates. It also enters into the composition of all of our ordinary cultivated plants, as well as into the muscles, tissues, and fluids of most animals. It is very insoluble, requiring 5,142 times its weight of water at 60° F.; and 36,000 times its weight of boiling water to dissolve. It possesses all the properties of alkalies, uniting with acids, &c., but slowly absorbs carbonic acid from the air. With the acids, it forms salts, most of which may be made by the direct solution of the magnesian earth, or its hydrate or carbonate.

Magnesia, like lime, is applied to land in various states of chemical combination, the nature, composition, and properties of which, together with their modes of application, are as follows :—

Carbonate of Magnesia.

Carbonate of magnesia rarely occurs pure in Nature, but is prepared from Epsom salts, (sulphate of magnesia,) by precipitation, or by calcining the artificial or natural carbonate in an impure state. When pure, it is a white, inodorous, tasteless powder, possessing similar properties as the calcined magnesia of the shops and consists of

	Per cent.
Carbonic acid, - - - - - -	51.7
Magnesia, - - - - - -	48.3
	100.0

A ton, (2,240 pounds,) therefore, of pure, dry carbonate of magnesia contains about 1,082 pounds, and a considerable larger proportion of carbonic acid than is present in carbonate of lime.

One of the chief sources of obtaining magnesia for agricultural purposes is from magnesian limestone, which abounds in various parts of the globe, particularly on the banks of the Hudson, and in the county of Onondaga, in the State of New York. Where the magnesia is in a large quantity, the lime containing it, is decidedly injurious, and in some cases is so much so as to render it inadmissible for agricultural purposes. It is from these limestones that the hydraulic or water cements are made.

According to an analysis made by Dr. C. T. Jackson, a sample of cement-stone, from Ulster county, New York, contained the following ingredients:—

	Per cent.
Water,	1.182
Silicic acid,	10.087
Carbonic acid,	41.200
Sulphuric acid,	0.606
Lime,	25.087
Alumina,	3.395
Per-oxyd of iron,	3.274
Magnesia,	12.890
Oxyd of manganese,	0.606
Potash,	0.706
Soda,	2.182
	100.000

A sample of calciferous sandstone from the State of New York, as analyzed by Professor Emmons, gave the following results:—

	Per cent.
Insoluble matter, silica, &c.,	6.20
Alumina and per-oxyd of iron,	4.50
Carbonate of lime,	58.86
Magnesia,	27.20
Water and loss,	3.24
	100.00

Another sample from Onondaga, New York, as analyzed by the same chemist, contained

	Per cent.
Insoluble matter, silica &c.,	3.74
Alumina and per-oxyd of iron,	0.18
Carbonate of lime,	89.00
Magnesia,	4.00
Phosphate of lime,	0.03
Water and loss,	3.02
	100.00

The Onondaga limestone, however, may be regarded as a pure calcareous rock, or as pure as ordinary chalk and most limestones, which are employed for agricultural purposes.

When the carbonate of magnesia, contained in common limestone, is heated to a high temperature in the open air, the carbonic acid it contains is driven off by the heat, and the lime and magnesia remain behind in a caustic state. When heated in this way, the carbonate of magnesia parts with its carbonic acid more readily, and at a lower temperature, than the carbonate of lime.

The caustic or calcined magnesia contained in lime "shells," like quicklime, slakes and falls to powder when water is poured upon it, and forms a hydrate of magnesia. It likewise swells and becomes hot, but not in an equal degree with pure lime.

Hydrate of magnesia, when pure, consists of

	Per cent.
Magnesia, - - - - - - -	69.7
Water, - - - - - - -	30.3
	100.0

Thus it will be seen that magnesia increases in weight during the process of slaking more than lime—one ton augmenting to nearly 3,200 pounds of hydrate.

When limestone, containing magnesia, is burned and afterward slaked, the fallen mass consists of a mixture of two hydrates in proportions which depend upon the chemical composition of the limestone employed. An important difference in these two hydrates is, that the hydrate of magnesia will harden under water or in a wet soil, in about eight days—forming a hydraulic cement. The hydrate of lime will not so harden; but a mixture of the two will harden under water, and form a solid mass. In the minute state of division, in which lime is applied to the soil, the particles, if it be a magnesian lime, in wet soils, or in the event of rainy weather ensuing immediately after its application, will become granular and gritty, and cohere occasionally into lumps, on which the air will have little effect. This property is of considerable importance in connection with the further chemical changes which slaked lime undergoes when exposed to the air, or when buried in the soil.

Although magnesia is essential to the perfect growth of plants, if introduced in a caustic state in a large quantity into the soil, it is believed by some to produce a very bad effect, and lime that contains it in excess should therefore be avoided. Caustic or calcined magnesia is much more injurious to vegetation than lime, from its retaining the caustic quality longer, and not uniting with carbonic acid so readily. It also forms a harder mortar with water, and is more apt to cake about the stems and roots of herbage; but mild magnesia, provided there is a deficiency of calcareous matter in the soil, is of service to vegetation, being found in ash of most plants in all probability replacing lime.

It seems to be the result of experience, however, that magnesia, in the state of a carbonate, is but slightly injurious to the land; some deny that in this state it has an injurious effect at all. This it is feared is doubtful; we may infer, however, with some degree of probability, that it is from some property possessed by magnesia in the caustic state, and not possessed, or at least in an equal degree, either by quicklime, or by carbonate of magnesia, that its evil influence is chiefly to be ascribed.

Now, there exist in the soil, and probably are exuded from the living rootlets, various acid substances, both of organic and inor-

ganic origin, which it is one of the functions of lime, when applied to the land, to combine with and render innoxious. But these acid compounds unite rather with the caustic magnesia, than with the lime which is already in combination with carbonic acid—and form salts, that generally are much more soluble in water than the compounds of lime with the same acids. Hence, the water which goes to the roots reaches them more or less loaded with magnesian salts, and carries into the vegetable circulation more magnesia than is consistent with the healthy growth of the plant.

As the accuracy of the preceding remarks can scarcely be doubted, since it has been verified by numerous practical farmers and by an already time-honored use, it must be conceded that limestone, rich in magnesia, but not containing it in excess, yields the most powerful and lasting fertilizing effects—a conclusion which would indeed be opposed to previous opinions as to the value of manuring lime, as it is customary to estimate its quality simply by its degree of purity. At the same time, this would assign a higher importance in regard to the growth of plants to magnesia, of the influence of which so little is certainly known, and which has been declared sometimes an injurious, sometimes a useful, and at others an indifferent constituent of the soil.

A circumstance which affords a still stronger support to the deduction expressed above, is the constant predominant proportion compared with lime assumed by magnesia in ripened seeds. For instance, well-known investigations of the ashes of various kinds of grains show a per-centage of magnesia $11\frac{1}{10}$ against $3\frac{4}{10}$ of lime, and the analyses of the ashes of twenty kinds of peas grown in most various soils and districts of $8\frac{3}{10}$ to $4\frac{1}{2}$. And with very few exceptions, a similar predominance of magnesia is exhibited by other kinds of seeds, the mineral constituents of which have not as yet been examined. For the proportion of magnesia exceeds that of lime approximatively 2 to 1 in peas, vetches, beans, madder, the quince, buckwheat, linseed, &c.; 3 to 1 in wheat, rye, oats, barley, coffee, &c.; 8 to 1 in maize and millet, and the seeds of pines and firs. On the other hand, the opposite condition occurs regularly in the leaves or stems of plants, and in the wood of trees; in which portions the lime has always the upper hand of the magnesia, and exceeds in from 2 to 8 times greater quantity. The researches from which the above figures are derived were made in Germany, England, France, and America; their agreement, therefore, can scarcely be regarded as an accident, but must be held as the expression of a definite natural law. If we learn nothing exact from them concerning the manner in which these two earths favor the growth of plants, the constant occurrence of them in all plants, on the one hand, teaches us that they are both always necessary to their development and maturation, whilst their constant proportion to each other in the seed and in the herbaceous structure warrants, on the other hand, the assumption that magnesia is especially necessary for the perfection of the seed, and lime for the development of a herbaceous and woody structure.

It is well known that we always meet with the greatest quantity

of phosphoric acid in the seed, and we conclude from this that it constitutes a principal condition of abundant and vigorous development of seed, as is decisively enough confirmed by practice, which shows that manure, rich in phosphoric acid, can produce much and heavy grain. Magnesia, among the mineral constituents, keeps the most equal pace with phosphoric acid, and we might readily conjecture from this, that these two substances exercise an especially important influence upon the production of the principal constituent of the seed—which we term sometimes gluten, sometimes albumen, and at others, casein—and cause the more abundant or scanty development of those, according as they are present in a greater or less quantity. Indications in this direction seem also to be given by the recent researches on those animal substances which are of similar composition to the albumen, gluten, and casein of plants; such as the albumen of eggs, the muscular substance of horses, the human brain, as also top or bottom portions of yeast, and other fungi in the vegetable kingdom, in which, in like manner, more magnesia than lime has been discovered.

In practice, however, in the formation of seed, magnesia is of far less importance and value to the farmer than phosphoric acid, for the simple reason that it is more universally and abundantly diffused in Nature than the latter.

Caustic magnesia, applied to lands charged highly with rich manure, in a proportion not exceeding one-fifth part of the animal or vegetable remains, is speedily rendered mild by the carbonic acid with which it is supplied, as the manure decomposes; but it should never be thrown upon land where a portion of quicklime already occupies the surface; because, while the quicklime is becoming mild by its more ready attraction for carbonic acid, the magnesia retains its caustic property, and acts as a poison to most plants. It will destroy woody fibre the same as quicklime; and in combination with strong peat, assists in forming a manure. If the peat equal one-fourth part of the weight of the soil, and the magnesia do not exceed one-twentieth, the proportion may be considered as safe. Where lands have been injured by too large a quantity of magnesian lime, peat will be an efficient remedy.

Chloride of Magnesium.

When calcined or carbonated magnesia is dissolved in muriatic acid and the solution evaporated to dryness, a white mass is obtained, which is a chloride of magnesium. This compound occurs not unfrequently in the soil, associated with chloride of calcium. It is met with, also, in the ash of plants, while in sea-water, and in that of some salt-lakes, it exists in very considerable quantity. Thus, 100 parts of the water of the Atlantic have been found to contain $3\frac{1}{2}$ of chloride of magnesium, while that of the Dead Sea yields about 24 parts of this compound. Hence, it is present in great abundance in the mother liquor of the salt-pans, and it is from the refuse chloride

in this liquor, that the magnesia of the shops, as above stated, is frequently prepared. Chloride of magnesium, when pure, contains of

	Per cent.
Chlorine, ...	73.65
Magnesium, ...	26.35
	100.00

This substance has not hitherto been made the subject of direct experiment as a fertilizer. From the fact, however, that plants require much magnesia and some chlorine, there is reason to believe that, if cautiously applied, it might prove beneficial in some soils, and especially to grain-crops. Its extreme solubility in water, however, suggests the use of caution in its application. The safest method is to dissolve it in a large proportion of water, and apply it to the young plant by means of a water-cart. In this way, the refuse of the salt-works might, in some localities, be made available to useful purposes. The chloride of magnesium is decomposed both by quicklime and by carbonate of lime; hence, when applied to a soil containing lime in either of these states, chloride of calcium and caustic or carbonated magnesia will be produced.

Nitrate of Magnesia.

Nitrate of magnesia is formed by dissolving carbonate of magnesia in nitric acid, and evaporating the solution. It attracts moisture from the air with great rapidity, and runs into a liquid. It is probably formed naturally in soils containing magnesia, in the same way as nitrate of lime is known to be produced in soils containing lime. Few, if any, direct experiments have yet been made as to its effects upon vegetation; but there can be no doubt that it would prove highly beneficial, could it be procured at a sufficiently cheap rate to admit of its economical application to the land.

The nitrate of magnesia, when pure, contains of

	Per cent.
Nitric acid, ...	72.38
Magnesia, ...	27.62
	100.00

Phosphate of Magnesia.

Magnesia exists in combination with phosphoric acid, in the solids and fluids of all animals, though not so abundantly as the phosphates of lime. In most soils, phosphate of magnesia is probably present in minute quantity, since in the ashes of some varieties of grain it is found in very considerable proportion.

The action of phosphate of magnesia upon vegetation has rarely, if ever, been tried directly; but, as it exists in urine and in most ani-

mal manures, a portion of their efficacy may be due to its presence. In turf-ashes, which often prove a valuable manure, it is sometimes met with in appreciable quantity, and their beneficial operation in such cases has been attributed in part to the agency of this phosphate.

Phosphate of magnesia, when pure, consists of

	Per cent.
Phosphoric acid, ...	63.33
Magnesia, ...	36.67
	100.00

Silicates of Magnesia.

In combination with magnesia in different proportions, silica forms nearly the entire mass of those common minerals known by the names of serpentine and talc. Silicates of magnesia exist in considerable quantity in hornblende and augite. They must, therefore, be present in greater or less abundance in soils which are directly formed from the decomposition of such rocks. Like the silicates of lime, however, though more slowly than these, they will undergo gradual decomposition by the action of the carbonic acid of the atmosphere, of the acids produced in the soil by vegetation, and by the decay of organic matter. The magnesia, like the lime, will then be gradually brought down, in a state of solution, from the high grounds, or washed out of the soil, till at length, it may wholly disappear from any given spot.

Silicate of magnesia, when pure, contains of

	Per cent.
Silicic acid, - - - - - -	69.08
Magnesia, - - - - - -	30.92
	100.00

Sulphate of Magnesia.

Sulphate of magnesia, the common Epsom salts of the shops, is formed by dissolving carbonate of magnesia in diluted sulphuric acid. It exists in nearly all soils, which are formed from, or are situated in, the neighborhood of rocks containing magnesia. In some soils, it is so abundant, that in dry weather, it forms a white efflorescence on the surface.

Sulphate of magnesia, when pure, is composed of

	Per cent.
Sulphuric acid, - - - - - -	32.4
Magnesia, - - - - - -	16.7
Water, - - - - - -	50.9
	100.0

This salt has been found by Sprengel to act upon vegetation precisely in the same way as gypsum does, and on the same kind of

plants. It must be used, however, in smaller quantity, owing to its great solubility. Its higher price will prevent its ever being substituted for gypsum as a top-dressing for clover, &c.; but it is worth the trial, whether barley plants, the grain of which contains much magnesia, might not be benefitted by the application of a small quantity of this sulphate—along with such other substances as are capable of yielding the remaining constituents which compose the inorganic matter of the grain. D. J. B.

BREAD CROPS.

WHEAT.

THE PROPER TIME FOR REAPING.

From a very careful series of experiments made in England, in 1840–'41, by Mr. John Hannam, of Yorkshire, with the view of determining the proper period of reaping wheat, it was decided that the best time for performing the operation is, when it is in a "raw" state, or when the straw, as seen from a distance, appears green, but, closely examined, is found to be approximating to yellow, and the grain itself, being separated from the chaff, is pulpy and soft, but not in the milky stage. This gentleman has shown that, at least $6 per acre are lost by allowing the wheat to become ripe before it is cut, and that, at the same time, its quality is not so good.

The chief advantages derived from this method are stated to be a greater weight of grain to a given space of ground, which produces more flour, of a superior quality; the straw contains more nutritive matter, and is better relished by animals; and there is a better opportunity of securing the crop, and a saving in so doing, as there is less waste in moving or reaping the wheat by the dropping out of the seed.

Like all other operations in the vegetable economy, the ripening of the seed consists entirely of various chemical processes, the nature of which need not be explained here, but the results should be carefully considered, in order to arrive at a conclusion as to the modifying influences of different modes of culture. When an ear of wheat first fills, it appears almost entirely composed of a substance resembling milk; in about a week or ten days after this, if we examine the crop, we shall find the seed much more solid, the milky juice having hardened and consolidated, and the straw having begun to wither, which it always does from the ground to the ear. At this period, the straw will be yellow for about a foot above the ground;

in another week or ten days, the crop will be perfectly ripe; that is to say, the straw will be uniformly yellow up to the ear, and the chaff will be sufficiently loose to admit of the grain being rubbed out by the hands. On examining the ear, the most perceptible difference which has taken place since the last period will be that the skin will have become much thicker and harder, while the flour will be diminished in quantity. Now, this is the important point, namely, that the last change in the seed is an excess of bran, and a relative diminution of flour, which change increases materially, according to the length of time which elapses between the ripening and the harvesting of the crop. From the above, it would appear, then, that it is the farmer's interest to cut his wheat before it becomes thoroughly ripe. D. J. B.

PRODUCTION OF NEW VARIETIES OF WHEAT BY CROSS-FECUNDATION.

The improvement of agricultural plants by cross-fecundation is a subject of the highest importance. It is quite as feasible as the hybridizing, or cross-breeding in animals. It often involves, however, very extensive inquiry, and when applied to the production of new varieties of wheat, the interests of the farmer, the miller, the baker, and of the consumer are all to be duly considered.

In addition to what was given on this subject in the Agricultural Report of the Patent Office, in 1855, it may be stated that, in performing the operation, it is not only necessary to guard against the fertilization of the ovary from its own anthers, but that it is requisite that all the other anthers of the same ear, above the ovaries artificially fertilized, should be extracted; otherwise, they will pour out the contents of their pearly globules to the relief of the feathery stigmas, and disappoint the experimenter's hopes. For, more than ordinary care is taken by Nature that the grass tribe, which includes wheat, shall be fertilized by its own pollen. An opinion has long prevailed that wet weather injures the grain while it is in blossom. This opinion is erroneous, inasmuch as, in wet and very hot weather, fertilization is carried on within the chaff. "Often in moist weather" says Mr. Maund, the experimenter referred to, in the Report as above, "have I felt much interested, when, wanting pollen, I have held the straw and bottom of the ear in my warm hand for two or three minutes, watching for a crop of anthers. Quickly, the ripest of them, stimulated by the warmth, would peep out from their seclusion, and, gently rising, give me a chance of capturing them ere they scattered their contents over the expectants beneath them. Sometimes, on leaving these excited ears, and returning to them after ten or fifteen minutes, I have found several anther-cases as empty as balloons, dancing to the breeze, as if joyous that in my absence they had scattered every pearl they possessed." D. J. B.

POTATOES.

PROPOSED REMEDY AGAINST DISEASE.

Like all plants which are extensively cultivated under varied circumstances of soil, climate, local condition, and artificial treatment, the potato is extremely subject to disease. Complaints on this subject have been made from time to time for a long period of years; but as the peculiar features of the maladies with which this plant has been affected were never minutely nor accurately noted before the recent microscopical observations and careful researches in organic chemistry, nor were in a condition to lead to any satisfactory results, it is impossible at present to ascertain anything certain with respect to any former ravages. There are but two theories, which, in the existing position of the question, seem at all tenable—the "Fungal" theory and that which ascribes the disease to injudicious cultivation pursued through many years. It is not the intention of the writer to decide between them; and though he is disposed to favor the former, which gives full conviction to many minds, he is free to confess there are great difficulties in the way, and it is quite impossible, in the present state of our knowledge, to determine, in all cases, the true cause.

The "potato murrain," as it has often been called, one of the most prominent forms in which the disease has appeared, was the most disastrous in the United States in the year 1844; and, on the authority of M. Gay and Acosta, it has occurred for ages on the western coast of America, particularly in Chili and Bogotá. It was first observed in a serious form in Great Britain and Ireland, in 1845, though there were slight indications of it on the continent of Europe a year or two before.

Mr. Wilhelm Protz, of Germany, in a treatise on "The Nature of the Disease of the Potato, the True Cause of its Predisposition, and Measures proposed to restore it, by adopting a Natural Method of Cultivation," attributes the malady to be the result of too wet a spring, followed by a hot summer. By close observation during a period of seven years, he discovered that the disease, under the most varied influences of the weather, generally presented the following features:—

1st. The disease did not appear in any form before the time of flowering of the plant, which exhibited up to that stage an apparently healthy and vigorous growth.

2d. The disease, which manifested itself by the rapid withering and dropping of the flowers, without permitting them to produce

seed-balls, as well as by the leaves and stalks dying off more or less quickly, was much more decided in its progress during a wet season, in a moist soil, and after an application of green or unfermented manure, than on dry, unmanured soil during a long continuance of fair weather.

From an experience of many years, it was observed by the author that application of fresh manure showed its effects rather in the vigorous development of the haulm of the plant (stalks and leaves) than in an actual increase of the crops of tubers, a fact by which he felt himself induced to adopt the method of not planting potatoes with unfermented manure for 20 years. It often came under his observation that the haulm of the potato had a peculiar power of imbibing water. During the fall of a gentle rain, the surface of the grass and the leaves of other plants would show the drops of rain much sooner than the haulm of the potato, on which there could often be discovered no moisture even after the lapse of ten minutes; and they became dry at least an hour earlier than any other plants.

Some 20 or 30 years ago, when the potato-crops in Germany were in a healthy condition, it was noticed that the haulm grew to only about half the height they had in those years in which the potatoes were the most diseased, and that they had less volume, remaining at that time, in a perfectly green state, during September, and retained this color nearly up to the time of harvesting, in October. Exceptions now and then occurred in varieties of an early maturity, which, however, never lost their green color before they had fully ripened. In those years in which the potato was the most diseased, it was observed that the haulm generally grew to much larger proportions, which to the inquiry how it was that they attained such increased dimensions, and this just at the time when the tubers assumed a sickly disposition, seldom reaching their normal size. Aided by previous recollections, Mr. Protz came to the conclusion that the greater development of the haulm, and the consequent disease, is owing to high manuring; for, the more voluminous the haulm, the more numerous must be its organs for receiving water, which would cause too large a flow of sap, or juice. To this superfluity of water in the plant, he attributes the cause of the malady in question.

In discussing the nature of the potato-plant, the author shows that, in consequence of a varied and often injudicious cultivation, for a century at least, in which it had been richly manured, it had gradually degenerated; that its stalks and leaves have become too luxuriant in their growth, and contain too much watery sap, not sufficiently assimilated for the natural reproduction of seeds. He further shows that the destiny assigned to this plant by Nature is not only to produce tubers, from which we can propagate an abundance of healthful food for man and animals, but, also, seeds for the purpose of multiplying varieties. The latter mode of propagation, however, he contends cannot be performed, if this plant contains too much water, as the cells of the stalks will not be sufficiently condensed, or hardened into wood. The flowers will fall without forming capsules, and the further development of the plant will be checked

just at that important stage of its vegetation preceding the commencement of the formation of the seeds; the progress of the upper part of the stalks will cease, and, wherever such is the case, a fungal growth ensues, which is always the effect, but never the cause, of the disease. This species of vegetation also exhausts those powers of the plant which should have been directed to the accomplishment of its natural destiny. The effect of this disease on the tubers is dependent on the weather; for, in dry, warm seasons, they resist the spreading of the fungi, which wet seasons so favor that the stalks and leaves, as well as the organs of respiration, will soon be destroyed. This affects the tubers, partly in a direct way, as they are no longer allowed a regular growth, and partly by means of the fungi themselves, which attack them, first choosing those lying uppermost. All tubers not directly affected are presumed to be healthy, growing, however, only to a very imperfect degree; the sap is liable to decompose; and in storing them they are observed to betray symptoms of decay. Wherever the haulm are dying off, before the seeds have matured, the disease has set in, and the deficiency of real nutritive matter (starch) is greater than is commonly supposed. The effects of the malady, however, vary, according to the nature of the varieties of the plant, and of the soils in which they are cultivated.

The author is of opinion that, to restore the degenerated potato, the following mode of culture should be adopted: As this plant is evidently unable to produce seeds, when in a degenerated state, we must resort to the tubers, which have the faculty of propagation. After selecting the best of these, expose them to the air, sheltered from the rays of the sun, till they become thoroughly dry; then bring them into a room, free from frost, and completely cover them with dry ashes of peat, or of mineral coal. Plant the seed, thus preserved, without being cut, in separate, well-prepared and deeply-cultivated ground, properly drained. A field which has furnished several crops since last manured will be the best for this purpose, and no manure should now be applied. Repeat this process, annually, and, in a few years, a perfect cure may be expected.

The potato, originally an insignificant and rather woody tuber, by treatment for many years, with rich manures, has attained its highest perfection. Now, in attempting to force it beyond its capacity, we find the result only degeneration and disease. Therefore, we must return, and comply with the laws of Nature, till, by a careful and moderate diet, we restore this tuber to its normal strength.

D. J. B.

THE CHINESE YAM.

(*Dioscorea batatas.*)

From two years' experience in the culture of this new esculent in this country, we can safely rely upon its adaptation to our soil and climate; but how far it can be depended upon as an alimentary basis as a substitute for the common potato, can only be determined by further experiments. It doubtless will be cultivated to a considerable extent, as a garden luxury, and will possess advantages over the potato such as always being in a fit state for cooking, whether kept in or out of the ground, exposed to frost or cold, dryness or heat, provided the place where it is stored, is not too moist or wet.

The aspersions and prejudices which have been advanced or created against this root, within the last eighteen months, have arisen from a want of knowledge of its habits and the disadvantages under which it has often been grown. For instance, most of the seed, which has thus far been planted in this country, consisted of small tubers, propagated from the vines, not possessing, in many cases, sufficient substance to maintain the vitality of the plants; and even when they did, it was in so feeble a degree as not to allow the growth to make much progress before the second year. Good tubers, however, or pieces of the same, cut from $1\frac{1}{4}$ to $2\frac{1}{2}$ inches long, if planted early, will form fine, large roots the first season.

The proper time for planting is early in the spring, after the ground has become settled and ceased to freeze. All forcing is useless, or even propagating in pots, which, in fact, in our warm climate, is decidedly injurious. The soil may be of almost any description, except it be too wet; but a light, sandy loam is to be preferred. In other words, the more permeable the soil, or the more readily it may be made so, the deeper the roots will penetrate the earth. Well-rotted manures are the only ones which should be used, and these so deeply covered that they will not come in contact with the tubers when first planted. The land should be subsoiled or spaded to a depth of 12 or 18 inches, and the manure covered deeply, so as to be near the bottom. The ground being thus prepared, ridges may be formed, 3 feet apart, from centre to centre, by turning two furrow-slices together, then, after levelling their surfaces with the common rake, plant the tubers or cuttings about a foot asunder and an inch deep, leaving the eyes upward. Having thus performed the simple task of planting the tubers, they will require no further attention than an occasional scuffling of the surface, to keep down the grass or weeds, until the period when the vines will have spread over the ground.

The amount of labor in the general culture of this plant is less than that required for the ordinary potato. By midsummer, the roots penetrate, perpendicularly, deep into the earth, being at that

time slender and long; but after the middle of August, when the nights become cooler, they begin to enlarge at the lower end, and continue to increase in diameter till the occurrence of heavy frosts. The digging of the crop, therefore, in the northern parts of the United States, if deemed necessary to be done in the fall, should be deferred up to the time just before the freezing of the ground. They may be stored, when dug, in a dry cellar or airy room. The roots sustain no injury by ordinary freezing, neither in nor out of the ground. If left in the earth during winter, they vegetate on the return of spring, and continue to enlarge up to the period of heavy frosts at the end of Autumn. It has been stated that they resemble the roots of the dahlia in their growth, increasing in size for four or five years, then changing into several tubers, or sets.

When it is designed to propagate new tubers from the vines, in the Middle and Northern States, they should be covered with earth, about the middle of August, allowing their leaves to remain just above the surface. The seed-tubers, or pseudo bulbs, will then be rapidly formed, so that, by the middle of October, they will be sufficiently mature to separate from the axils of the leaves. Some persons adopt the mode of dividing the vines into short cuttings of a single joint each, which they cover in beds of sandy loam, whence new tubers will readily spring; but this process is more laborious than the method of simply covering the vines. D. J. B.

TEXTILE AND FORAGE CROPS.

PRODUCTION OF SISAL HEMP IN FLORIDA.

BY WILLIAM C. DENNIS, OF KEY WEST.

The progress of Sisal hemp (*Agave sisalana*) during the past year, in this vicinity, has proved very satisfactory. In the spring of 1855, I first observed a kind of blast, or blight, on some of the leaves of this plant. It was generally confined within one-third of the extremity of the leaf, and usually appeared in a circular form; yet often irregular and of various dimensions. I could not perceive that these spots increased in size, after their first development, nor that they injured the growth of the rest of the plant. In the course of the summer, they became white and shrivelled, though the other parts of the leaf still retained their vigor. Within a year after, the fibres in these infected places assumed a dark color, and their strength was somewhat impaired, but the fibres of the rest of the leaf continued

as strong as those from leaves untouched by the blight. Again, in the winter of 1855–'56, both here and on the adjacent islands, this blight showed itself rather to a greater extent than it did the previous winter; but thus far, in the present season, (January, 1857,) there is not the least indication of its attack.

It is too soon, perhaps, to determine the cause of this evil, for it is possible that it may be the effect of an insect or a fungoid growth; but I believe it analogous to frost-bite, and that the excessive rainy and damp weather of the last two winters, accompanied by cold and violent winds, is the cause.* In addition to the frequent, slow, drizzling rains, attended by cold, strong winds, with almost constant cloudiness, and a saturated state of the air, in the winters of 1854–'55 and 1855–'56, the thermometer showed a mean temperature of 65° F. for the three winter months of the first, and 68° for those of the second; while the mean of the winter months of 1852–'53 was 72°, and of 1853–'54 it was 70° Although the winter of 1854–'55, when this blight first appeared, was colder than that of 1855–'56, when it had rather increased, yet the last-named winter was the most rainy, cloudy and damp, and was followed by a very cool March; but the record of the past 25 years does not show a parallel to either of those two winters. In fact, this region is celebrated for its clear, bright weather during the winter, so that, if I am right in my conclusion that this blight was caused by dampness and cold combined, its frequent occurrence need not be apprehended. The plant evidently requires dry, hot weather, as well as a dry soil; for, since I have observed its growth, I have never seen it suffer from drought in the driest and hottest weather, and in the most arid spots, provided its roots could find a plenty of the right kind of soil. The meteorological record for the last 25 years shows that this plant is well adapted to these Keys, and the southern extremity of the peninsula; for such winters as the two designated are evidently rare.

It would seem that there are lands enough in Florida, south of the limit where the frost would injure this plant, to grow it in sufficient quantities for the present and prospective wants of the country; and that, too, in a frontier region which it is of national importance to settle. As far as known, these lands are not well adapted to an extended range of agricultural products, yet I am certain that the tropical agaves, in all their varieties, will flourish here in the greatest perfection.

Mr. Hermonds, of Indian River, Florida, says, that Sisal hemp grows well there, and has continued to thrive well, for years. He thinks that my last year's estimate of the product per acre is too low for that region. The experiments I have made, within the past year, in getting out a number of tons of this fibre, convince me that there are but few difficulties in accomplishing this work cheaply. These experiments prove that, if all the vesicles of the leaves are

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* Is not this irregularity produced by the abrasion of the prickles of the leaves from the action of the wind? D. J. B.

ruptured, by crushing or rolling, the pulp and gum are easily washed out either by salt-water or fresh. The plan which I found most successful was to roll the leaves, being careful to rupture all the vessels; then confine these crushed leaves in an open-work, wooden frame or box, which I placed in such a manner, that the tides forced the sea-water through them both at the ebb and flow. In this manner, the gum and pulp were so far washed out, in from three to six days, (according to the temperature of the air and water,) that, by beating the fibres a little, after they were dry, they were fit for market. *

Mr. Hermonds mentioned, as a tested fact, that steeping the crushed leaves in boiling water, even for a few minutes, at once dissolved the gum and cleaned the fibre. This renders it almost certain that, where a steam-engine is used to propel rollers and crush the leaves, the waste steam can be rendered effective, to clean this hemp, by blowing it off between the rollers, aided by a little water, in a jet, while the leaves are passing through.

The amount of the imports and consumption, in this country, of fibres similar to Sisal hemp, in 1854, was over $2,500,000, of which more than $1,500,000 was for Manilla and Indian hemps, and over $1,000,000 for gunny-bags and cloth, jutes, &c.

I am of opinion that this hemp can be cleaned, and cheaply, by running the leaves through a series of powerful rollers, having water dashed on them during the operation; and this plan would be much facilitated, in this region, from the fact that the gum of the leaves seems equally soluble in salt-water as in fresh. But experiment must decide which of the methods would be the best. Care must be taken not to allow the leaves, or fibres, to come in contact with the mud, or other substances, which will stain them while they are in a damp state; and it will be well to have them in the sun, or strong light, while under the process of cleaning and drying; for the juice of the plant is both a saponaceous and a bleaching fluid.

Last year, I spoke of the fact that the celebrated pulque plant (*Agave pulque*) was introduced by Dr. Perrine. It grows enormously large here, where there is sufficient depth of soil, and although I presume that the mean temperature is too high to make from it the Mexican drink, yet alcohol could be distilled from its juice, and probably the leaf can be made to yield a cheap and abundant material for paper. The ancient Aztec made much of the paper, on which his picture-writing was transcribed, out of the leaves of one or more of the varieties of the agave; and this pulque plant, most likely, is one of the kinds; for its thick, fleshy leaves, containing very fine fibres, are sometimes 8 feet long and from 7 to 8 inches broad.

* Would not this method be objectionable on account of the difficulty of drying the fibre or the materials manufactured therefrom? D. J. B.

COTTON.

PRODUCTION, COMMERCE, AND MANUFACTURE IN VARIOUS COUNTRIES OF THE GLOBE.

At the suggestion of several gentlemen interested in the production as well as in the trade of cotton, a Circular was issued from the Patent Office on the 29th of February, 1856, and forwarded through the Department of State to our Diplomatic and Commercial Agents, Missionaries, Officers of the Navy, and other Public Functionaries, residing and travelling in the principal countries of the globe, soliciting from them such information on the subject as might be at their command, to which were appended the following questions:—

1. What species or varieties of cotton are cultivated, if any, in * * * ?
2. Are the varieties annual or perennial, or both?
3. What varieties are cultivated to the best advantage?
4. How long have they been cultivated there, and from what country were they obtained?
5. Has the general character of the cotton fibre, as to length, strength, or uniformity deteriorated since its introduction?
6. What amount, in pounds, is produced per annum in * * * ?
7. What amount, in pounds, is exported, if any, and to what countries?
8. What amount, in pounds, if any, is manufactured, and what is the character of the goods?
9. What is the usual price of ginned cotton fibre per pound?
10. Is it ginned by the roller or saw-gin?
11. How much fibre do 100 pounds of unginned cotton yield?
12. Where are the gins manufactured?
13. How is the cotton packed, by hand, by screw, or by press, and how many pounds in a bale?
14. What is the cost of the production of a pound of fibre, well ginned?
15. Are the soil and climate well adapted to its profitable growth?
16. What is the maximum, minimum, and mean of the thermometer of each of the cotton-growing months?
17. What amount, in inches, of rain falls during said months?
18. What is the usual mode of cultivation?
19. Is manure employed for the crop, and if so, what kinds are the most economical and the best?
20. In what months are the seeds planted?
21. What months are the plants in flower?

22. What months is the cotton harvested or secured?
23. What is the usual yield to an acre?
24. What is the value of cotton-land per acre?
25. What is the annual rent per acre of cotton-land?
26. What causes, if any, operate injuriously to the cotton-crop, either by insects, climate, or the physical, political and social condition of the inhabitants?
27. Can you give any other information which will have any bearing on the question?

REPLIES.

Reply of Edwin De Leon, *Consul General of the United States, at Alexandria, Egypt.*

There are three species of cotton cultivated in Egypt, namely:—

1. The "Native" cotton, which, in Lower Egypt, has been entirely superseded by the Indian and American cotton, though still cultivated near Thebes, and in its vicinity, and used in domestic manufactures, but never exported. It is of very inferior quality.

2. The "Mako," or "Jumel" cotton, which constitutes the great bulk of Egyptian, and is grown all through the Delta. It is a long-stapled cotton.

3. The American "Sea Island," which has been cultivated in small quantities for the last 15 years, but which has not had a great success.

These varieties are all perennial here, but are sown annually, which is more profitable. Formerly, the plants were allowed to remain two or three years; but after the first year, they are now rooted up, and fresh seed sown. The Mako variety is preferred, but there is a growing inclination to increase the culture of the Sea Island. The Native cotton of Upper Egypt has been cultivated from time immemorial. The Mako was discovered by M. Jumel, in Mako Bey's garden, about 1818, and introduced generally in about 1820. It is the prevailing impression that the Mako thrives better than the Sea Island, which latter, after the second year, degenerates and requires fresh seed to be sent from America.

The interrogatory respecting the annual product of cotton in Egypt cannot be answered with perfect accuracy, owing to the character of the people and the system of government. An approximation would be about 40,000,000 or 50,000,000 pounds. The exports, in 1821, were 60 bags, of about 100 pounds each; in 1822, 50,000; in 1823, 120,000, and in 1824, 140,000 bags. The subjoined comparative tabular statement, derived from official sources, showing the quantities shipped from Alexandria, and the countries to which they were exported, for a period of three years, from 1853 to 1855, both inclusive, would indicate an increase in the culture by no means rapid in successive years:—

YEARS.	POUNDS OF COTTON EXPORTED TO				
	Great Britain.	France.	Austria.	Elsewhere.	All countries.
1853,	26,439,900	10,726,500	6,321,000	397,800	43,885,200
1854,	24,938,700	7,454,100	10,165,200	988,500	43,646,500
1855,	33,980,100	9,451,200	12,774,900	668,100	56,874,300
Aggregate,	85,358,700	27,631,800	29,261,100	2,054,400	144,306,000
Average,...	28,452,900	9,210,600	9,753,700	684,800	42,102,000

If to the aggregate exported be added 5,000,000 or 6,000,000 pounds, worked up in the country, a liberal estimate of the annual amount of the cotton-crop of Egypt will have been made.

The quantity now manufactured is merely to supply the army with uniform (nizam) and coarse goods, (baftas,) not exceeding 2,000,000 pounds per annum. Probably, an equal or a greater amount of raw cotton is used for stuffing divans, which, in every house, constitute the sofa by day and the bed by night. In the time of Mehemet Ali, there were twenty-four factories, and 20,000 men employed. Now, but one large, and three small mills are in operation—the first worked by steam and the others by ox-power, employing about 2,000 persons. Baftas (domestics) are made white and blue.

The usual price of ginned cotton fibre is from $8 50 to $12 per cantar of 100 pounds gross weight, in the villages where it is grown; or, in Alexandria, the principal market, $9 50 to $14, gross weight. This is equal to 6 or 8½ cents per pound, net weight, on shipboard.

Of the cotton grown here, nearly all is roller-ginned. Saw-gins from the United States have been tried, but they were found to cut the cotton. The roller-gins, which are manufactured in the country, consist of two rollers placed obliquely, one of iron and the other of wood. They are turned by the foot, a fly-wheel being used. The yield of fibre is estimated at 66 per cent. The cost of the production of each pound of fibre, I am unable to ascertain. In the country, the cotton is packed in round bags both by hand and by roughly-made screw presses. In Alexandria, it is formed into square bales by hydraulic presses, of which there are several at Mint-el-Bassal, the great market near the city. The bales average about 300 pounds each. I have obtained permission from the Viceroy for the erection of a steam cotton-press by an American citizen.

The soil and climate might be said to be adapted to the profitable culture of cotton, but the yield depends greatly on the rise of the Nile, as no rain falls except in December.*

The deposits of the Nile in the periods of its overflow constitute the only fertilizer of the soil. The ordure of the animals of burden is used for fuel by the Fellahs.

The seeds of cotton are sown from the 21st of March to the end of April; the plant begins to flower early in July, and continues flowering until December, or even until February or March; and the crop is chiefly harvested from the beginning of September to the middle of October. The yield varies very much. That sown in winter, called "baaly," and which is watered only by the inundation of the Nile, produces on an average 200 pounds to the acre. That watered by means of the sakias, (water-wheels,) and called "miskawi," gives 300 pounds. The maximum of 500, and even 700 pounds, has been obtained, but very rarely.

Almost all the land in Lower Egypt is suitable to the growth of cotton, though not of equal value for this purpose. The price varies from $25 to $125 an acre, and the rent from $5 to $15, the tax being paid by the owner out of this rent.

With respect to the causes operating injuriously to the cotton-crop, Abda Rahman Bey, an officer in the civil service, and a very intelligent man, says: "To answer this query, one would have to make a long and serious investigation. I believe that the great protection now given to agriculturists, especially to the Fellahs, will have the effect to improve the cotton-crop, as well as all other productions of the soil. In the last three or four years, the production of grain has been more profitable; but the causes which have rendered it such ceasing to exist, the growth of cotton and flax will be resumed with greater energy. Improved and cheaper means of irrigation, and a reduction in the expenses of carriage to the port of embarcation will necessarily cause an advantage and advance in the cultivation of cotton, which I consider to be as yet in its infancy. A point worth consideration is the great difference in the price of the produce, which runs from $7 to $10, and even $20, per 100 pounds. With more care and more intelligence, the best qualities must increase in quantity."

The cotton is very little injured by insects, the chief obstacles being the superior advantages of grain-growing, and the unskilled labor of the country, which, in agriculture, is performed exclusively by the "Fellahs," (peasantry,) a peculiar race, who live under a system very similar to that of the serfage of Russia. The black slaves in the country are entirely employed in domestic duties, and fare better and labor less than the peasants. They are chiefly Nubians and Abyssinians.

The government, that is to say, the Viceroy, owns a large portion of the land, which is either farmed out to rich individuals of the

* For an account of the cotton climate of Egypt, see Agricultural Report of the Patent Office for 1855, p, 328 D. J. B.

nigher class, or under the charge of the governor of the district. The Fellah is not permitted to leave his bailiwick, and gets of the proceeds of his labor just as much as pleases the proprietor, which is generally the minimum of subsistence. He lives in a mud-hovel, and tastes animal food but once a year, and when he does so, as a religious duty on the feast of Bairam. Like the Emperor of Russia, the present Viceroy has made some experiments in making the Fellahs nominal proprietors of small pieces of land; but the exactions of the Turkish officials never leave them much margin of profit. The labor is, therefore, performed in a slovenly manner; and, as the Fellah is very ignorant, improvements cannot be well introduced. Dr. Davis' experiments in Turkey have been repeated in Egypt by foreigners without success. The system of irrigation is admirable, and our planters might take lessons from it; but, in every other respect, the culture is defective to the last degree. Intercommunication is good—through the Nile, the canals leading into it, and the railroad; and the cost of transport is comparatively moderate.

A demand has sprung up in England for the cotton seed, for the manufacture of oil and oil-cake, and all that can be spared is readily disposed of, at the rate of 30 cents a bushel. The same manufacture is attempted on a small scale at Cairo, and with good results.

The cotton-culture has been pursued for 30 years, and, although a large body of land in the Delta might be devoted to it, the increase of late years has been small, and, in my judgment, under the present condition of things, will be augmented but slowly.

The cotton is not only badly cultivated, but is slovenly handled afterward, and it is brought to Alexandria in very poor condition generally. Under an improved system of culture, and with skilled labor, or a better organization of that at hand, the yield might be greatly increased. The Mako is a long-stapled cotton compared with our Uplands, but shorter than Sea Island; the gins sent out from the United States cut it severely, and are not adapted to it, yet much loss is experienced in the use of the prevailing means of cleaning.

Manufactories have been found unprofitable. More from pride than for profit, the soldiers' uniforms are made in Egypt, but the same species of goods is obtained better, and cheaper for the quality, from abroad. That there is a market here for our manufactures, I have endeavored for the last three years to impress on the minds of our countrymen. I have even procured and sent to exporters and manufacturers in the United States samples of the cotton goods in demand here, with the prices indicated, and *pro-forma* bills of sale. But, on this point, as more conclusive than my own, I hereunto subjoin the opinion of an experienced merchant, long connected with the South American trade in cotton goods, who spent the winter and spring of 1854 in Egypt, who says:

"In 1853,	Imports of manufactured goods from England, - - - - - -	£353,000
	Imports of manufactured goods from France, - - - - - -	242,000

"Egypt has no trade with the United States; but there is a good field open for something to be done in that way, as the coarse cotton goods, which we manufacture so extensively for China and South America, and which defy English competition in those markets, are precisely such fabrics as are required by the common people of this country, namely, blue, bleached and unbleached sheetings and shirtings, to which might be added cotton drills, blue, bleached and brown ticks and stripes.

"Lumber of all kinds for building purposes might also be introduced, as well as staves for the sugar refineries and distilleries, boots, shoes, wooden-ware, and an infinity of articles manufactured in New England, especially the common kinds of iron-ware and edged-tools, which can be furnished from thence cheaper than from England, and of better quality."

Pro-forma Account Sales, Charges, and Net Proceeds of 1,000 *pieces Shirtings, No.* 7, 40 *yards.*

1,000 pieces shirtings, No. 7, @ $3 40 @ 3 months, -		$3,400	00
Charges.			
Import duty, 4 per cent., - - - - -	$136		
Porterage, - - - - - - -	7		
Store rent, ½ per cent., - - - - -	17		
Brokerage, ½ per cent., - - - - -	17		
Shroffage and loss on money, 1 per cent., -	34		
Commission and *del credere*, 6 per cent., - -	204	415	
		2,985	
Remitted.			
£600 1 11 @ 3 mos. date ex. 98½, - - - -		2,955	45
Remitting commission 1 per cent., - -		29	55
		2,985	00

Reply of JOHN J. MAHONY, *Consul of the United States, at Algiers.*

The Sea Island, long-stapled, and Nankin or yellow species of cotton, are cultivated in Algeria. They are all annuals. In the summer of 1854, the planters were advised to try to make these varieties perennial, by letting the plants stand for the ensuing season. With a few isolated exceptions, however, they were killed by the winter rains. The long-stapled variety is cultivated to the best advantage, as, being first to mature, it is less exposed to the autumnal rains than the other sorts.

The cotton-plant had been grown with varying success in the Botanical Nurseries of this colony since 1847, when, three years ago, the Emperor offered a bounty to encourage its cultivation in Algeria, and the government agreed to purchase, at several times its market value, all that might be grown here. The seed came from the United States, through the French consul at Charleston. I have seen but one good specimen produced here, which was grown in the province of Oran. The deterioration, in every sense of the term, is so rapid that imported seed is required almost every year.

The product of 1854 amounted to 180,552 pounds. There are no manufactories of cotton in Algeria; the entire crop is exported to Havre, where it is sold on account of the French government. Some of the farmers take the seed out with their hands, but most of them deliver their cotton as they pick it. The only gin I have seen is a small wooden machine, with rollers, which was on exhibition here. It was only capable of ginning, with the assistance of a man, 6 pounds of fibre in twelve hours. There are three receiving houses, one located at the principal government nursery in each province, where there are one saw and six MacCarthy gins. Of Sea Island cotton, 100 pounds unginned yield 27 pounds of fibre, and of the long-stapled species, 23 pounds. The saw-gins were manufactured in the United States, and the MacCarthy gins were probably made in France, from an American model. Of the six gins in this province, only one works tolerably well.

The cotton is packed by being screwed—either into long or square bales containing 198 pounds each, the long bale being used for the Sea Island, alone.

I find it impossible to ascertain the cost of producing cotton in Algeria, but something may be learned from the fact that, notwithstanding the high prices paid by the government, its cultivation is for the most part abandoned because of its unprofitableness. The soil is doubtless well adapted to its production, but the climate is unfavorable, in consequence of the lack of rain, the very light dews, the heat of summer, and the almost incessant rains of autumn.

The cotton is planted in rows about 2 feet apart, hoed four times, and irrigated every four days, or as often as the water can be spared from other plants. Stable manure is sometimes applied; but few farmers pay any attention to dressing their fields. The seeds are planted from the 15th of April to the 10th of May; the pods begin to form in July; the plants are in flower from September to February; and the harvesting commences in September and lasts until the following spring. From any data in my possession, I cannot venture a statement respecting the usual yield to an acre.

Up to this time, the government has made donations of land. In nany instances, the recipients, for the most part, who are protected by persons of influence, have disposed of their concessions at about $5 an acre. The value of the land in this colony varies in proportion as the following questions may be satisfactorily answered: Is the location healthy, or is it so unhealthy that it is dangerous to sleep on it? Can the land be irrigated? Is it liable to be inundated

by the torrents which rush from the mountains in the spring? Is it located near a place offering a cover for lions and panthers? The wild beasts of this country are a great annoyance to the farmer, as they devour his stock and frighten the herds, so that it is with difficulty they are kept together. Most of the farms are worked by poor families, who receive half the net proceeds.

The climate of this part of Algeria is not adapted to the cultivation of cotton. It cannot be planted before the middle of April, as has already been intimated, because of the liability of the seeds to perish from the excessive moisture of the land; and it consequently does not arrive at maturity before the occurrence of the autumn rains, which nearly stop its vegetation. In the fall of 1854 and spring of 1855, I watched with care the progress of the cotton-plant in some twenty different localities. On the 1st of October, about 15 per cent. of the crop had been picked in a damaged state, being tender and wet, when housed. From that time to the 1st of February, about 12 per cent. more was gathered in a worthless condition, the pods being but partially opened, having been continually saturated with water, so that half the contents of every bud was decayed and quite black. Of the remainder, or nearly three-fourths of the whole crop planted, with the exception of a few which cracked, the pods looked as fresh and as green in the spring as they had in the preceding August, although the plants were dead at the roots.

Oran is reported to be better adapted to the growth of cotton than either of the two other provinces; yet it is well known that the culture there, last year, was almost exclusively confined to persons believed to be connected with the factories of France, the failures of the preceding season having been so ruinous as to deter the poor farmer from trying it again.

Reply of ROBERT L. SWANSTON, *Vice Consul of the United States, at Apia, Samoa, for the Navigator and adjoining Islands, South Pacific.*

Though no cotton is cultivated here, yet two indigenous species exist, one with the seeds all attached to each other, in a mass about 2 inches long; the other with single seeds interspersed through the pod. Both kinds are of a moderately good quality, and doubtless susceptible of improvement by cultivation.

The soil and climate are admirably adapted to the growth of these cottons; and, as the thermometer averages about 80° F. in the shade all the year round, they are perennial.

During the dry season, say from May to October, the cotton is in its best condition; it bears, however, quite freely in the wet season. It grows wild all through these islands, and attains the height of 12 feet, with a diameter through the stem of 3 inches. The Samoans make no use of it except for the wicks of lamps.

Reply of Jonas King, *Consul of the United States, at Athens, prepared by Mr. Chalekiopoulos, a Greek lawyer, and editor of a monthly periodical, called the "Agricultural Newspaper."*

The varieties of cotton, in Greece, I have not been able to ascertain. The short-stapled, which I am told never grows above a foot in height, is generally cultivated in the Peloponnesus. That of Livadia, in Continental Greece, is somewhat longer, and grows at most but 2 feet in height. That of Thera (one of the islands) is also short-stapled, and grows more than 5 feet in height.

The cotton is generally sown annually. That of Livadia is perennial, as the roots sprout the following year; but no one, I believe, takes advantage of this property, because all consider it more economical to sow it yearly. That of Thera is perennial. From no comparison which has been instituted can I determine what variety is cultivated to the best advantage; nor is it known, as I am assured, even by the professors of natural history, or of archæology, how long the various kinds of cotton have been cultivated in Greece, nor from what country they were obtained; but it is supposed they were derived from Asia.

Whether the cotton has deteriorated in length, strength, or uniformity since its introduction, I am equally unable to learn; nor can I find any statistics by which to estimate the amount in pounds produced annually in Greece.

Very little cotton is ever exported. In 1845, 177 bales, amounting to about 71,000 pounds, were carried to the Ionian Islands, chiefly, and perhaps some little to Turkey.

About 40,000 pounds of the cotton of Livadia is spun into yarn, No. 1 to 14, in the manufactory at Patras. All the rest is made into lamp-wicks and batting for coverlets, or is spun with the spindle by the country-women, and woven into strong, coarse cloth.

In the Peloponnesus, ginned cotton is generally retailed at about 15 cents a pound; but in Livadia, whence the greater part comes, it is valued at about 8⅔ cents. The charges for transportation are very heavy.

The saw-gin is unknown in Greece, and a wooden cylinder, called *anemidion*, is used. With this the laborer, during a whole day and night, can clean from 15 to 20 pounds, for which service he receives his food and a tenth part of the cotton ginned. There are smaller machines, called *anemodoura*, which are very imperfect, and with which women clean very small quantities. About 25 or 30 pounds of fibre are obtained from 100 pounds of unginned cotton. That of Livadia yields about 33 pounds to the 100. The gins are made by the mountain peasants. Each one takes a machine on his back and carries it from village to village, and then places on his shoulders the little produce of his labor, together with the machine, and returns to his home. With the exception of one American machine,

none has hitherto been introduced from any foreign country. The manufactory at Patras buys the cotton of Livadia and cleans it at the former place; but the expense of transportation greatly enhances the cost. The screw press for packing cotton is unknown in Greece. The cotton is packed by hand, and tied up in little balls of two pounds' weight, so as to be hung up to the roof.

The cost of production of a pound of well-ginned fibre is doubtless less, in general, than the market price. The expense of cultivation, compared with the income, is reckoned as follows:

	Per cent.
Ploughing,	15
Seed,	5
Hoeing,	25
Harvesting,	12
Cleaning,	12
Impost and usufruct,	25
	94

Of course, when the harvest is poor, the income is very small.

The climate appears to be well adapted to the profitable growth of cotton, but the soil is not sufficiently rich. Of the newly-imported varieties, that which is called "Nankin" succeeds wonderfully, and its fibre, which is abundant, is gathered in September. The American cotton, of Georgia, does not succeed so well. When sown in April, according to the manner of the country, it comes up healthfully, yielding many pods, which, however, do not mature, when it becomes necessary to gather them in October and November, during the rain, and when the leaves are falling. If the mode of cultivating this variety were known, it is thought that it might succeed well in all the warmer parts of Greece.

I know of no observations having been made as to the maximum, minimum, and mean temperature of the cotton-growing months, except those of the professor who has the direction of the Observatory, at Athens, which are confined to the months of July and August, and the first nineteen days of September of the year 1853, as published in a periodical called the "Pandora."

On the coast and on the plains, rain seldom falls during the three harvest months, June, July, and August, and when it does rain the quantity is very small.

The ground is ploughed for cotton in January, and the clods are subsequently well broken. If the field has any *agriada,* (dog-grass,) the women follow after the plough and gather it. Before cotton seeds are sown, they are rubbed with damp earth, in order that they may be more easily scattered. They are then covered by a superficial ploughing. When the plants attain a certain growth, the earth is dug with a hoe by men or women, and, at the same time, they are thinned. If necessary, the land is hoed a second time. As soon as the plants begin to blossom, the tops are broken off. The cotton is

usually gathered with the pods, out of which it is taken at the house. That the dry leaves may be broken as little as possible, they are generally gathered in the morning, when the dew is on them. In places where much cotton is raised, the fibre only is gathered. Manure is seldom applied, except as it is deposited on the fields by the cattle and sheep.

The seeds are sown early in April; the plant is in flower in June and July; and the cotton is harvested in August and September. These dates, have reference to the old-style computation of time, and are, in fact, twelve days later than our computation.

The short-stapled yields about 60 pounds of fibre to the acre; that of Livadia, from 240 to 300 pounds.

When the Greek government formerly sold lands at auction, and on credit, the medium price was about $21 an acre for untilled lands; but the public sales have ceased, and the cultivator can now sow cotton on public lands by paying one-tenth of the produce to the government, as the tax imposed on all produce, and an additional 15 per cent. for the use of the land, which latter is called *epicarpeia* (usufruct.)

The causes operating injuriously to the cotton-crop are the following: There is a worm, or insect, which destroys what is sown early in March, and the moisture rots that which is covered deep with the plough; cattle and flocks of sheep often graze undisturbed; the cultivators are ignorant, and they want capital; they have not proper implements of labor, nor facilities for the transportation of produce from one place to another, in an economical manner; they have not proper machines for cleaning the cotton, and the demand for it is too little to induce them to cultivate it to any considerable extent; and, finally, the political and social condition of the inhabitants—the great number of feasts, which induce idleness and neglect of business pertaining to husbandry—the want of encouragement from the government—the unsettled state of the country—and, for some time past, the fear of robbers operate injuriously, not only to the cultivation of cotton, but to agricultural pursuits, in general.

In the time of the Turks, the farmers raised all the cotton necessary for home consumption, and the women spun and wove it; but, since cotton cloth began to be imported, as well as cotton yarn, which the peasants use and weave into clothing, the Greeks have considered the cultivation of this product as less important.

Reply of DON PABLO ANGUERA, *Consul of the United States, at Barcelona, Spain.*

No cotton is produced in this consular district. The quantity manufactured within it appears approximately to be the whole 100,000 bales received at this port, yearly, on an average, brought from

New Orleans, Charleston, and Mobile, in Spanish vessels, with the exception of an insignificant number of bales of Brazilian cotton, also imported.

The character of the manufactured goods may be considered coarse and of low quality, in general. They are all consumed within the kingdom of Spain.

Reply of A. B. Boyd, *Consul of the United States, at Aspinwall, New Granada.*

Cotton is not, nor am I aware of its ever having been, cultivated here. This country is doubtless well adapted to its growth. A considerable quantity is procured by the natives, and used for bedding and other household purposes.

Reply of Edward Ely, *Consul of the United States, at Bombay, British India.*

There are three varieties of cotton cultivated in Western India, namely, the "Open-podded," indigenous, called "Broach;" the "Close-podded," also indigenous, called "Dhollera;" and the exotic "New Orleans" or "Sea Island." The first-named is that most generally cultivated, though inferior to either of the others; the second is only produced on the western side of the gulf of Cambay, over an extent of about 100 square miles; and the American cotton is cultivated throughout Western India, though in small quantities.

The cotton-plant in India is annual, the dry season invariably killing the roots, except in such marshy grounds as retain moisture during the eight months of drought. The American cotton requires much more moisture than the indigenous varieties, and can therefore be planted only on low, marshy grounds, or where irrigation can be employed. It is cultivated to greater advantage than the others, when the planter has sufficient capital to sustain the occasional loss of a whole crop. The indigenous cotton is seldom much injured by an unfavorable season, and, though less remunerative in its yield, is always planted by the native growers on that account. It has been cultivated and manufactured ever since our first knowledge of the country. The American plant was first introduced about the year 1840, since which time, the East Indian government has employed several experienced American planters for the purpose of establishing it as the staple in preference to the native varieties. The American cotton has slightly deteriorated in the length of its fibre, but not otherwise, since its introduction.

The amount of cotton produced in the districts under the Bombay government, or in those under native rule, and contiguous to Bombay, is about 250,000,000 pounds, annually; and this amount may be called the annual produce of Western India.

Bombay is the only port from which the cotton is exported to foreign countries; and the following summary, for the period commencing May 1st, 1851, and ending April 30th, 1856, is as nearly accurate, though probably 5 per cent. short of the real amount:—

	Pounds.
1851–'52, - - - - -	195,710,024
1852–'53, - - - - -	197,881,840
1853–'54, - - - - -	172,036,925
1854–'55, - - - - -	153,947,800
1855–'56, - - - - -	217,487,413
Average of the five years, - -	187,412,800

The average quantity of cotton shipped annually from Bombay to the ports herein named for the last five years, is as follows:—

	Pounds.
Great Britain, - - - -	127,597,412
China, - - - - - -	54,454,107
Penang, Singapore, and Malacca, -	2,827,221
Arabian Gulf, - - - - -	774,865
France, - - - - - - -	311,720
Calcutta, - - - - - -	300,378
Genoa, - - - - - - -	211,781
Persian Gulf, - - - - - -	200,515
Gibraltar, - - - - - -	145,822
Antwerp, - - - - - -	122,830
Aden, - - - - - - -	122,153
Suez, - - - - - - -	84,330
Siam, - - - - - - -	57,725
Foreign ports of west coast of India, -	95,056
Coast of Coromandel, (India,) - -	31,856
Scinde, Cutch, and Goozerat, (India,) -	32,294
Coast of Africa, - - - - -	34,714
Mauritius, - - - - - -	8,221

About 62,500,000 pounds are annually manufactured into the coarse cloth worn by the natives, called "dungaree," and into finer fabrics known as "sarees," which latter are dyed in bright colors, and worn by females and the better classes. Very fine fabrics are sometimes manufactured, but it is all done by hand, and with machinery of the rudest construction.

The average price of ginned or clean cotton, at the village markets in the interior, where it is bought up by speculators, is about 5 cents, though it sometimes reaches 6 cents a pound; but the expense

of transportation over land and sea to Bombay, the profits of speculators and agents, and the charges for storage, wharfage, and pressing, at Bombay, when added to the original cost, give about 6½ cents a pound as the usual market value of cotton for foreign shipment. At the present and past rates of government assessments, or taxes, on the land, and with the exactions of native officials, the lowest possible rate at which cotton can be sold, at the place of production, is a little over 4 cents a pound, and nearly 6 cents at Bombay.

Cotton is ginned in India both by the saw-gin and an instrument called the "churka," which is very simple in construction, resembling a roller and breaker, and turning out about 40 pounds of clean cotton a day, by the labor of two men. The gin is used by large speculators, and is propelled by bullocks, turning out 500 pounds of clean cotton a day. The quantity of fibre obtained from 100 pounds of seed cotton is usually about 31 pounds. Some of the gins in use were made in England, but they are generally of Bombay manufacture. The ginning is done by speculators, who buy the cotton of the native growers at the market villages. It is then immediately packed, by means of screws, into bags or loose bales, containing 392 pounds each. When these arrive at Bombay, they are put into the steam screw and hydraulic presses, and condensed to the uniform size of 4 feet 3 inches length, 2 feet in width, and 18 inches in thickness.

The cost of ginning has not been estimated as an item of expense in the production of cotton, the seeds being the compensation of the parties who perform this work. The seeds of the cotton of India are exceedingly rich and oily, and are extensively used for feeding cattle. The value is about 44½ cents per 100 pounds.

In direct reply to the query respecting the climate and soil, it may be stated that they are admirably adapted to the profitable growth of cotton. Fahrenheit's thermometer ranges in the cotton-growing months as follows:—

Months.	Maximum.	Minimum.	Mean.	Inches of Rain.
June, - - -	110°	79°	93°	19
July, - - -	102	78	84	18
August, - -	105	81	90	12
September, -	106	83	91	10
October, - -	100	83	94	6
November, -	100	79	83	4
December, -	98	71	81	—
January, - -	97	71	80	—
February, -	98	74	84	—
Total depth in nine months, - - - - - - - - - -				69

Cotton is cultivated by the natives exclusively, and in the most primitive manner. The ground is prepared during the dry season by digging up and burning the old roots; and, as soon as the rains set in, it is ploughed, and the seeds sown by means of a drill plough, in rows 18 inches apart, and covered by a board or log, dragged behind. The young plants appear in about six days, and nothing more is required than an occasional weeding and thinning. A strict rotation with other crops is observed, except when cotton is in demand. The ashes of decaying stems and roots, which are burned on the ground during the dry season, are the only manure used.

The seeds are planted immediately after the first fall of rain, which almost uniformly occurs on about the 10th of June. The plants are in flower from the middle of July to the 10th of August. The cotton is picked from the pods in March; but sometimes, in consequence of the ripening of other crops at the same time, the cotton is left as late as the 10th of April. It is then often found damaged from lying on the ground, or by the over-ripened pods.

About 105 pounds of cleaned and ginned cotton is the average product of an acre. The cotton-lands all belong to the East Indian government, or to the different independent Rajahs, and have no fixed value. The average annual rent per acre of cotton-lands is about $2; but the land varies so much in quality that this rate can only be taken as the medium of a wide range.

The climate is favorable to the production of large crops of cotton, and there are no insects that affect the plant; but the political and social condition of the people has operated, and will continue to operate, to the prejudice of the cotton growth and trade, so long as the country is under the government of the East India Company. The soil is admirably adapted to the growth of this staple; but not a tenth part of the cotton-lands is under cultivation, and that which is cultivated is managed so indifferently that scarcely a fourth of a crop can be said to be raised. The East India Company holds all the lands, and its agents in the several provinces assess the rents at the highest possible rates, in consequence of which, and also because of their liability to ejectment at any moment, the planters have but little interest in developing the resources of the land. The roads in India are the most wretched in the world, and many fine tracts of country are, for all agricultural purposes, totally inaccessible. Thousands of acres, in the vicinity of large rivers, might be made available by a little outlay for the means of irrigation; but the government is the landlord, and there is no spirit of improvement among the people. Should the crown of England assume the direct government of India, better hopes would prevail among those who desire that this country should advance to the position intended for it by Nature.

Reply of A. J. Bonnet, *Consul of the United States, at Bordeaux, France.*

Many experiments have been made in this and the adjoining Departements of France, within the last 15 years, in the culture of cotton, upon different varieties from India, Algeria, and America; but every attempt has proved an entire failure.

Reply of James A. Peden, *Minister Resident, at Buenos Ayres.*

The State of Buenos Ayres, in its present extent, is one of the largest and most productive of the Argentine Republic. It is situated on the west bank of the Rio de la Plata, having its northern limits in about 33° of south latitude, and extending according to the line indicated by its constitution, since its erection into a separate State, to the Straits of Magellan on the south. In all of this country, there is no cotton grown, or, if any, it is too small to enter into a calculation of the statistics. A large and the greater portion of the country is unoccupied. My own opinion is, that the soil, which is alluvial, and the climate, the nature of which you will derive from the table annexed, are not adapted to the culture of cotton. The soil, in geological language, is too "recent," although, judging from other vegetation, it would probably produce abundant seed. I do not think green-seeded cotton would either boll or mature well; and the same objection would apply with stronger force to Sea Island cotton. One of the absolute necessities of successful culture does not exist here, namely, there is not a sufficient intensity either of heat or cold, continuing the requisite length of season, to urge the rapid growth and maturity of the stalk, and to check vegetation by the winter cold. Frost is almost unknown, though the thermometer nearly indicates it, and I have sometimes seen ice. The annexed table will give the information desired as to climate and humidity; but I may here add, in response to the first of your interrogatories, that no cotton, or so little as to be considered insignificant, is grown in this State.

The Argentine Confederation lies mostly between 22° and 33° of south latitude, on the west side of the river Paraná, and east of the Uruguay, has many varieties of climate and soil, but the latter is for the most part subject to the objections indicated with regard to the soil of Buenos Ayres.

The climate, in summer, is sufficiently hot and dry, but the winter is less cold, generally, than in Buenos Ayres. I have seen cotton

grown in some places in very small quantities and under rude culture, for domestic use. The whole, or a large proportion of the produce of the Confederation, has hitherto passed through the city of Buenos Ayres, and a table from the work of Sir Woodbine Parish shows that, in 1826, a year of comparative peace, the product of cotton passing through this city was 2,000 arrobas, of 25 pounds each, or 50,000 pounds. I do not think, nor is it the opinion of merchants of experience here, that the amount has been doubled since the period named.

I believe that the varieties are both annual and perennial, the former prevailing in excess; though I have been told by a person, who had cultivated cotton to a very small extent, that the crop of stalks was generally left for two years, and that the ratoon was more productive in yield, and the fibre better. The variety was Sea Island, mostly deteriorated, though I saw some equal to first-class Florida cotton. Of the quantity produced, about one half is exported, and the other half consumed in the remote sections of the Confederation, in the manufacture of rude domestic goods for family use, for ornamental fringes, used by the "Gaucho," or peasant, and for various other purposes. I have seen a kind of towel, apparently made more for ornament than use, manufactured from the cotton of Entre Rios and Corrientes, equal to the same kind of fabric from the best Sea Island cotton in the United States. No manufactures of this material have been exported, so far as I am informed.

The cotton is prepared on a rude roller-gin, by foot or hand. Some gins of a better class have been imported from England, but I have not seen any of them, nor have I ever seen a screw or press of any kind, nor a bale of cotton. I presume it is packed by hand, or foot rather, as Sea Islands generally are.

I cannot learn with accuracy how much fibre is obtained from 100 pounds of green-seeded cotton, but, from the specimens I have seen, I should estimate the quantity at 25 pounds, or a little more. The seeds are as well covered as those of the Sea Island, generally, in Florida.

The cultivation is to the last extent rude. In many cases, the wooden plough, which merely scratches the earth, is used; and the hoe is applied so sparingly as to produce but little, if any, beneficial results. I have never heard of the application of manure of any kind. The seeds, if not left to ratoon, are generally planted in the late winter months, or the begining of spring. But much depends upon locality. I am of the opinion that, in Corrientes, Entre Rios and Santa Fé, they may be planted during all the winter months.

The value of land, of all kinds, is arbitrary and irrgular, but of course, depending on locality. Grants in eligible places are not much cheaper in the Confederation than are patents for wild lands in the United States; but in remote regions, exposed to the depredations of Indians, they may be obtained without other consideration than the condition of settlement. No discrimination is made between cotton-lands and those of other descriptions.

With respect to the causes operating injuriously to the cotton-crop, reference is made to the appended table of meteorological observations. The "langosta," or locust, appears in the State of La Plata about once in five years, but not in all regions at the same time. These insects destroy every vestige of verdure wherever they alight, and their number is greater than language can express. I regard them as more injurious in the main than the cotton caterpillar of our Southern States.

Neither the physical nor the political condition of the country is adapted to agricultural pursuits. The peasantry (Gauchos) have undergone no visible change in more than half a century. They are nomads, to a great extent, looking upon labor of all kinds, except the raising and attention to horses and cattle, as degrading; and the peculiar habits engendered by such a life are well calculated to strengthen their native prejudices. They are indolent, except in such of their vocations as may be followed on horseback; they are literally unfitted for walking, and, of course, for agricultural pursuits; and they are prejudiced, proud and insubordinate in many things, yet they possess many good qualities.

From their Moorish ancestors down to the present day, the Spanish race have not been remarkable as an agricultural people, and this race presents no exception to the general rule. There is a superabundance of land, and a laboring class with simple and almost primitive habits, yet bread, to a great extent, is unknown to most of the class called "Gauchos" and also to the "Peons," or laborers of the country. Beef is their only food, and the *yerba maté*, or Paraguay tea, their constant drink, or, by way of variety, *caña*, distilled from the sugar-cane of the West Indies or of Paraguay. Labor is hence deficient in kind and quantity, while capital is in excess. A peon laborer commands from $10 to $20 per month, a rate of compensation altogether too high for the profitable culture of cotton. The usually unsettled political condition of the country also exerts a depressing influence upon enterprises of this character.

The Banda Oriental, on the opposite side of the Rio de la Plata, is represented to be much better suited to this culture, both by soil and climate, than most of the other regions irrigated by its waters. Of this, however, I speak from report, and not from experience. Paraguay produces many varieties, among them the "Nankin" cotton, of short staple and very fine, which is said to grow wild, but to have been introduced by the Jesuits. It is cultivated to a limited extent, and efforts are made, by means of liberal offers, to induce persons acquainted with its management to prosecute its culture and preparation; but the scarcity of labor is an impediment there, also, though not to the same degree as in the Confederation. Yet the objection is insuperable for the present, and a century may elapse before any of these countries shall render the supply equal to the demand.

I am not familiar with the history of Paraguay, but incline to the opinion that, with adequate labor, experiments in the production of

cotton would there be attended with interesting results. I saw a variety of cotton at Pernambuco of very fine quality, and was assured by an American merchant there, that it commanded a higher price in Europe than any of our cotton; but the product was restricted. The variety was said to be perennial.

TABLE I.

Quantity and estimated value of Cotton exported from Buenos Ayres in the years 1825, 1829, *and* 1837.

YEARS.	Arrobas.*	Price.	Aggregate value.
1825, - - -	2,000	$2 50	$5,000
1829, - - -	968	2 00	1,936
1837, - - -	160	3 00	480

* An arroba contains 25 Spanish pounds.

TABLE B.

Meteorological Observations in Buenos Ayres, in 1822 *and* 1823.

(From the Registro Estadistico.)

Seasons.		Thermometer. Max.	Thermometer. Mean.	Thermometer. Min.	Barometer. Max.	Barometer. Mean.	Barometer. Min.	Hygrometer. Days humid.	Hygrometer. Days dry.	Winds. North to east.	Winds. North to west.	Winds. South to east.	Winds. South to west.
1822.													
Summer	January	91	71.82	60	No observations.					12	3	9	6
	February	89	73.00	58	30.04	29.58	29.21	19	9	12	8	3	5
Autumn	March	82	70.83	53	29.88	29.61	29.33	20	10	12	6	6	7
	April	78	62.04	43	29.82	29.73	29.46	22	8	7	8	4	11
	May	68	58.31	44	30.18	29.76	29.21	30	1	13	7	2	9
Winter	June	66	54.32	40	30.05	29.77	29.23	30	0	14	5	2	9
	July	68	52.55	38	30.17	29.65	29.21	31	0	13	4	7	7
	August	66	51.83	36	30.21	29.84	29.51	31	0	18	3	6	4
Spring	September	72	54.64	42	30.41	29.74	29.32	30	0	13	3	11	3
	October	81	58.91	46	30.13	20.67	29.24	30	1	17	5	5	4
	November	88	68.43	56	29.91	29·61	29.17	28	2	23	1	5	2
	December	86	70.91	62	30.00	29.45	29.15	23	8	16	3	6	6
								294	39	170	56	66	73
1823.													
Summer	January	94	75.31	60	29.92	29.54	29.25	5	26	17	4	5	5
	February	93	78.42	66	29.95	29.60	29.21	3	25	14	3	5	6
Autumn	March	93	75.79	52	30.02	29.88	29.18	19	12	10	6	9	6
	April	72	67.50	57	30.08	29.30	29.27	29	1	14	9	5	2
	May	63	52.50	41	30.14	29.79	29.53	31	...	11	12	6	2
Winter	June	65	52.50	40	30.15	29.68	29.15	30	...	16	5	9	...

In the eighteen months, the highest of the thermometer was 94° F. in the month of January; the lowest, 36° in August. It has been known to rise to 96°, as in January, 1824, when it was at that point some days. On the other hand, it has been known to fall as low as 28° and 29°, as in 1817; but these extremes are very rare.

TABLE III.

Results of Meteorological Observations at Buenos Ayres, during the five years, from 1817 *to* 1821.

Years.	1817	1818	1819	1820	1821
Highest of Fahrenheit's thermometer,.	83° Feb. 20	85° Feb. 9	85° Jan. 17	86° Jan. 13	85° Feb. 21, and March 9
Lowest of ditto in the shade, in-doors,.......	28° July 10	37° June 4	43° Aug. 3	38° July 5 to 10	41° July 20 to 24
Rainy days,.............	60	83	65	56	67
Days of thunder and lightning,..............	28	30	29	36	39
Violent gales,..........	Aug. 8, Sept. 6, and in Oct. and Nov.	Jan. 7 and 30, March 29, Sept. 27, Oct. 11, and Dec. 6	Jan. 8, 13, 25, and 31, April 20, Oct. 25, and Dec. 26	Jan. 26, June 10, and Aug. 20	Jan. 31, Feb. 12, and Sept. 7

Reply of Charles Huffnagle, *Consul General of the United States, at Calcutta, British India.*

The cotton-plant is indigenous in India, and has been cultivated by the inhabitants throughout the whole length and breadth of these extensive territories, from a period anterior to historical record. Some of the varieties are annual, while others are of several years' duration. All known varieties have been tested by the introduction of seeds from various parts of the world, and the institution of experiments on a large and liberal scale, from time to time, under the auspices of the government; but the cotton indigenous to the soil and climate has not been materially improved. That raised from the indigenous plant, on the western side of India, in the Bombay Presidency, commands the best price, and is principally selected for exportation. It is known in the London market as "Surats" and is grown near Surat, and at Broach. East India cotton may be said to be chiefly cultivated in the various parts of the Western Presidency, more especially in the Province of Goozerat, in the Madras Presidency, the line of country extending along the Western Ghauts to the Carnatic, Salem, Tinnevelly, &c.; in the Northwest provinces of Central India, parts of Behar; the Doab (especially the banks of the Jumna); the line of country through which the Delhi and Doab canals run; Rohilkund, Bundelkund, and the Nerbudda Valley.

The general character of the cotton fibre, as to length, strength, or uniformity has not deteriorated; but the staple of East India cotton is short and weak, and much better adapted to the very simple process of manufacture, peculiar to the natives of India, than to the machinery of America or Europe.

Uncleaned cotton, or cotton containing the seed, is called "kupas," which, when gathered, is stored with but little care, exposed to damp, dust, and discoloration. The seed is separated from the fibre almost exclusively by rollers; sometimes, by a roller under the foot, as indicated in the opposite cut, but more commonly by a simple contrivance called the "churka," by which two rollers are made to turn in opposite directions. This rude invention is still in use all over the country, notwithstanding the efforts made to supersede it by more efficient, but at the same time, more expensive apparatus. The poor "ryot" (villager) cultivates his patch of cotton; his wife and children pick, clean, spin, and weave it; and the village carpenter supplies all the needful machinery. The gins used under the orders of the government, at Bombay, in all probability, have been imported from England. About 21¾ pounds of clean cotton are usually obtained from 100 pounds of kupas.

The cotton is at first packed by hand in large bales of coarse cotton or hempen cloth, and thus transported either in boats or in "hackeries" (native carts) across the country; but, when it reaches a port

for exportation, it is packed by screws in bales, measuring, at Calcutta, 10 cubic feet, and containing 300 pounds each; at Madras, in bales of 300 pounds; and at Bombay, in bales of 392 pounds.

The cost of cotton grown in the northwest provinces, and delivered at Calcutta, has been estimated at 3 cents a pound.

With respect to the anuual product of British India, it is almost impossible to obtain very correct data; but, as cotton forms, exclusively, the clothing of from 130,000,000 to 150,000,000 of men, women, and children, and their beds and pillows, ropes, carpets, curtains, &c., some idea may be acquired of the enormous quantity

needed for consumption. In 1840, Major General John Briggs, of the Honorable Company's Army, published a monograph, in which he assumes, from data apparently correct, that the quantity of cotton required for clothing, alone, is equal to 375,000,000 pounds, and adds as much more for the other purposes to which it is applied, making a total, exclusive for domestic uses, of 750,000,000 pounds. In an abstract, also furnished in the pamphlet above alluded to, I find that the aggregate quantity of cotton, the growth of India, imported

into England and China, during the commercial year 1833–'34, was 96,686,182 pounds. The chief exportation is to China. During the year 1855, the exports were as follows:—

From Calcutta.

				Pounds.
To China,	24,172	bales, equal to	- - -	7,251,600
Singapore	1,372	" "	- - -	411,600
Penang,	30	" "	- - -	9,000
Hamburg,	3	" "	- - -	900
Liverpool,	169	" "	- - -	50,700
	25,746			7,723,800

From Bombay.

				Pounds.
To China, Singapore,	200,000	bales, equal to	- -	78,400,000
London, Liverpool, Glasgow,	175,000	" "	- -	68,700,000
Other ports,	25,000	" "	- -	9,880,000
	400,000			156,980,000

From Madras.

				Pounds.
To Singapore,	32,976	Madras maunds, equal to	-	824,400
Great Britain,	72,436	" " "	-	1,810,800
China,	4,560	" " "	-	116,000
	109,972			1,751,200

The cloth manufactured for clothing is, in general, light, weak and flimsy, an important exception being the celebrated muslins of Dacca, manufactured by hand, in damp rooms, from a peculiar description of cotton grown in the neighborhood of Dacca, and along the Delta of the Megna.

Cotton cleaned by the "churka," or foot-roller, is sold by the maund of 82 pounds. The present price at Calcutta is 10 rupees and 8 annas per maund, or more than $2\frac{4}{5}$ cents a pound. At Bombay, cotton (kupas) imported into that presidency, from the neighboring districts, is cleaned by the cotton-gin, under the management of government officials, and sold for export, but whether as an experiment, merely, I cannot say.

It should here be noted that a very large proportion of the cotton exported from India to China is used by the Chinese as padding, and is valued simply as a material for quilting their silk dresses, worn in the cold weather.

The soil and climate may be pronounced well adapted to the profitable culture of cotton. Soil, fertile in a moderate degree, only, is preferred. In richer lands, the plants become very luxuriant, but produce more woody fibre and leaves, and fewer pods in proportion. A dry soil and a dry atmosphere, at the time when the pods are ripening, seem to be necessary for successful production. The plant rises during the heavy periodical rains, and when these cease, the pods ripen, and the cotton comes to maturity during the dry season.

The mean range of Fahrenheit's thermometer throughout the year is as follows:—

Localities.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Calcutta,.........	71°	71°	85°	88°	93°	88°	84°	86°	87°	83°	73°	72°
Madras,...........	77	78	81	86	88	89	88	86	85	84	79	76

In Bengal, the periodical rains commence about the middle of June, and terminate with October; and the mean fall, in Bengal and adjacent provinces, as indicated by registers kept at forty-three military stations, is 76.18 inches; but the quantity of rain over this extent of territory varies in a remarkable degree. Thus, the average fall at Calcutta, as shown by the above data, is 64.14 inches, while, at the same season, and during the same period, the fall at Darjeeling, (a sanatory station for the British troops, in the Sikkim territory, latitude 27° 3′ 9″ north, about 318 miles north of Calcutta, having an elevation of 7,400 feet above the sea-level,) is registered as having reached $610\frac{1}{4}$ inches in five months, though the annual fall of rain here is usually estimated at 120 inches. In the Madras Presidency, the fall of rain indicated by a register of observation, for nine years, gives the mean quantity at 51.27 inches.

As has been stated, we find cotton in cultivation in every part of India—on the borders of rivers—far in the interior of the land—on the sea coast—on mountain elevations of from 4,000 to 5,000 feet—and on level plains. The seeds are often sown broad-cast; sometimes with other crops; and the plants are generally crowded together. But in some districts, where comparative attention is paid to the culture, the seeds are sown in drills, and the plantation is protected from weeds. Manure is never applied to the cotton-lands.

The time of planting varies considerably; but, as a general rule, it is performed in Upper India at the commencement of the rainy season, and in Lower India, at the close of that season. The plants are in flower, in Upper India, at the commencement of the cool season (November); in Lower India, at the close of it; that is, at the approach of the hot season. After the periodical rains, the plants

begin to flower, and these rains begin, in Upper India, about the 15th of June, and, in Lower India, in October. In Bengal, a small crop is gathered as early as December; but the more ample yield is during the hot weather of April and May following. The gathering season depends upon the geographical position and climate. In Upper India, the harvest commences with the hot season; in Lower India, about June. In the Madras Presidency, under careful cultivation and superintendence, 108 pounds of clean cotton to the acre are considered a fair yield.

The cotton cultivation may be said to extend from the extremity of the peninsula of Hindoostan to the great Himalaya range; and, as the value of land depends upon population, fertility, price of labor, suitableness from geographical position for certain crops, &c., it is impossible to give anything upon this head. The rent of land depends upon the value of the crop. Large tracts, upon which oftentimes several villages are situated, are taken from the government at certain fixed rates per annum, by middle-men, called "Zumeendhars," and these let the land to the ryots, or small farmers, and exact a rent in accordance with the ability of the latter to pay.

With respect to the causes operating injuriously to the cotton crop, it may be stated that the poverty of the ryots and their prejudices against innovation, stand in the way of all improvement. Although the value of the cotton, such as it is, might be materially enhanced by a little care in picking the pods, storing the kupas, or seed-cotton, after harvest, and in separating the fibre from the seed, they adhere to the practices of their forefathers, and cannot be prevailed upon to profit by any of the modern improvements in agriculture. A longer drought than usual kills the cotton-plant; too much rain rots it; and, if a shower happens to fall at the season of harvest, insects attack the ripe pods, and the dampness discolors the fibre.

In 1840, the Court of Directors, with the aid of ten cotton-planters from the United States, commenced a series of experiments with fresh seeds; but the product of these seeds at once manifested a deterioration, which continued from year to year, until the plant had degenerated to an equality with the indigenous growth of the country.

Reply of G. EUSTIS HUBBARD, *Commercial Agent of the United States, at Cape Haytien.*

The cotton cultivated in Hayti is called "Ste. Marthe." It is an annual, and is believed to have experienced no change since the discovery of the island, when it was found here. It is of long fibre.

The largest amount ever produced in Hayti is believed to be the product of 1789, when from 9,000,000 to 10,000,000 pounds were grown. From 880,000 to 900,000 pounds are now annually exported

to Europe and the United States. The price paid by exporters is usually from 6 to 7 cents a pound. It is ginned by the saw-gin, only, and none is manufactured on the island. The gins are generally made in the United States. About 75 pounds of ginned cotton are obtained from 100 pounds of seed-cotton. It is packed by hand, in bales of from 100 to 400 pounds.

The soil and climate are very well adapted to the profitable growth of this crop, especially in the vicinity of Gonaives, Artibonite, Tiburon.

The seeds are planted, or sown, in ploughed ground in the month of May; the plants are in flower in October; and the cotton is harvested from January to March. Cotton-land may be purchased at from $3 to $10 an acre.

When heavy rains fall in November and December, the husks of the cotton fall off. In a very dry season, strong winds derange the fibre and carry it away. In March, the Palmer worm is injurious to the plant. These are the prominent causes of detriment to this branch of culture.

The quality of the cotton raised in Hayti has been pronounced superior, particularly that cultivated in the district of Tiburon, in the southern part. Nothing is wanted but industry and enterprise to render the cotton of Hayti a large and profitable article of export.

Reply of A. V. Colvin, *Consul of the United States, at Demerara, British Guiana.*

Cotton is not now cultivated in Demerara. For many years, it was the great staple of the colony, but eventually gave place to sugar-culture. Still, it may be seen growing spontaneously in many localities. It is a perennial tree, requiring very little labor after a good stand has been obtained.

I believe that no deterioration has ever been evinced in its fibre. On the contrary, it seems extremely well suited to the soil and climate of this region. The product of an acre is from 300 to 600 pounds. When it was in cultivation here, it was ginned with rollers manufactured in the colony. Any quantity of unginned cotton will yield about a third of its weight of fibre. The mode of packing was altogether by hand. I think the soil and climate are better adapted to its profitable growth than in any part of the United States. We have no winter, and the tree grows, blossoms and bears all the year. The hoe and the spade were the only implements used, and manure was never applied. I do not believe that the soil would be exhausted by the culture of cotton for a whole century. Planting may be performed in any month of the year; but April is usually preferred. A tree will no doubt bear for 50 years, if kept so trimmed that a man may reach to the top.

Cotton-land may be purchased at $1 an acre, but often rents for from 50 cents to $1. With respect to the causes operating injuriously to the culture of cotton, I would express the opinion that nothing more is needed than to induce the people to work.

To give an idea of what was formerly done here, in this department of industry, I will state a few facts: The cultivation of cotton was commenced in 1752. In 1775, 19,090 bags and 189 bales were exported; in 1803, 46,435 bales; in 1823, 9,587 bales, when the product began to decline and give way to sugar and coffee, of which large quantities were made. In the years 1823, 1824, and 1825, 6,808,913 pounds were exported; in 1826, 1827, and 1828, 7,389,373 pounds; in 1829, 1830, and 1831, 2,252,557 pounds. The quantity continued to decrease until 1838, when 641,920 pounds were exported. Since then, very little has been produced, and none now, while coffee has experienced a like fate, being almost entirely abandoned, though it grows luxuriantly, and without labor, when once a good stand of trees has been established. Sugar has been the all-absorbing crop, but, now that labor is so precarious, that is also fast falling away, though ten or twenty years are allowed to transpire without replanting after the canes are once planted.

Reply of A. Herbemont, *Consul of the United States, at Genoa, Sardinia.*

Cotton is not cultivated here, nor do I believe that it is in any other part of Italy, although the soil, climate, and seasons might suit it very well in many places.

The importation of cotton from the United States into this port is increasing in proportion to the facilities afforded by rail roads for its introduction into the interior of Italy, Switzerland, &c. From the 1st of January to the 31st of December, 1855, the direct importation from the United States, in American vessels, was 25,089 bales, averaging over 400 pounds each, equal to 10,035,600 pounds. From the 1st of January, 1856, to the present date, the 20th of June, which is less than six months, there have been brought in American vessels alone 30,410 bales. The quantity brought from India, Egypt, and other countries, foreign to our own, is inconsiderable, but the quality is generally inferior.

The manufactures of cotton, in this country, are chiefly of coarse goods, like our sheetings and shirtings, and the prices nearly the same, the cheapness of labor compensating for the freight and other charges on importation.

Reply of WILLIAM H. ROBERTSON, *Acting Consul of the United States, at Havana, Cuba.*

Cotton is not cultivated at present on the Island of Cuba. Its cultivation has been attempted. I do not know the cause of its discontinuance. Both annual and perennial varieties would grow here, but I think seeds brought from Mexico have proved the most profitable. Experiments were made with them twenty years ago, but I have no information as to the improvement or deterioration of the crops obtained. I regard the soil and climate as peculiarly adapted to the growth of cotton, at least where the soil has sufficient depth.

The plant flowers at all seasons. Land is worth from $5 to $10 per acre. The only cause I know operating against the culture of cotton is the want of hands.

I find in the official return of trade of the Island of Cuba for 1854, there were exported from Havana 1,304 arrobas (32,600 pounds) to Spain; 185½ arrobas (4,637½ pounds) also to Spain from St. Jago de Cuba, and 1 arroba (25 pounds) to the United States from Baracoa. I believe this cotton was raised on the island.

Reply of THOMAS MILLER, *Consul of the United States, at Hilo, Island of Hawaii.*

Cotton is not cultivated at present in this island. About 15 years ago, it was introduced, whence I have been unable to ascertain; but, judging from the seed and fibre, it is my opinion, as well as that of others more familiar with the article, that it is of the Sea Island variety. It attains a height of from 4 to 6 feet, and is perennial, which may be owing to its being transferred from a colder climate to a country in which there is no winter. It was at first cultivated, and small quantities were manufactured into cloth for domestic purposes; but since the commencement of the importation of cheap cottons (muslins) from the United States and elsewhere, the cultivation and manufacture have been abandoned.

I regard the soil and climate as well adapted to the profitable culture of cotton, and believe that in many places very little labor would be required in its production. I am informed by the Rev. T. Coan, the resident missionary here, that he has seen this cotton growing spontaneously and luxuriantly in fields covered with a kind of lava called "clinkers," where there was no perceptible soil, and, of course, where no ploughing, or hoeing, would be required, or even practicable. These fields, containing thousands of acres, might be bought of the government, in fee simple, for 25 cents an acre, and probably for less, as they are now perfectly useless. Land of a better description, upon which the hoe and plough might be used, could be pur chased at 50 cents an acre.

The cause which would operate injuriously to the cultivation of cotton on an extensive scale on the Sandwich Islands, would be found in the difficulty of procuring efficient labor; for the natives, always averse to work, are becoming still more so every year. A person emigrating from the United States, with the view of entering upon the cultivation of cotton here, must therefore not depend on native labor.

Reply of DANIEL SARGENT, *Consular Agent of the United States, at Inagua, Bahama Islands.*

Cotton is not cultivated here at present, but formerly the "Georgia," a perennial, and the "Anguilla," an annual, were cultivated, the Georgia to the best advantage. These varieties were introduced about 70 years ago; and I do not learn that they deteriorated in quality; nor do I understand that any attempts were made at manufacturing cotton goods here, the whole product having been sent to England.

The ginning was done with rollers, which were rough machines manufactured on the plantations and propelled by wind.

The cotton was packed by hand into large, round bags, or sacks, suspended by the mouth, and containing from 300 to 400 pounds each.

The soil, though rocky, is considered good, and the climate favorable. The thermometrical observations give a range from 67° to 88° F.; 77° being considered a fair average of the year. September, October, November, and December are our most rainy months, when the fall of rain is equal to about 4 inches a month. The cotton was planted in rows, and the hoe was the only implement used; nor was manure ever applied. The seeds were usually planted in March, and the plants were in flower every month in the year. The cotton was harvested at all seasons, but the best in November and December. The product was at least 300 pounds to the acre. The government price for land is 6 shillings sterling per acre, or about $1 38.

The depredations of the cotton-bug, and occasional droughts, operate injuriously to the crop; but the indolence of the people, and the comparative ease with which they can subsist, by fishing and raising green provisions, and their remarkable propensity for wrecking, which engages the time and attention of a majority of the adult males in the Bahamas, and, socially, their utter indifference to the happiness and comfort of themselves and their families, are also causes adverse to the culture of cotton.

With energy and industry, all tropical fruits, Indian and Guinea corn, sweet potatoes, and all varieties of culinary vegetables may be produced in abundance. This island is now, however, engaging very extensively in the manufacture of salt of a superior quality from the water of the numerous ponds. Large investments have

been made within the past six years. One railroad has been constructed, and another projected, for facilitating the transportation of the salt to the place of shipment; and I believe there is no doubt that Inagua will, in a few years, become by far the most important point in the West Indies, and probably in the world, for the production of salt by solar evaporation.

Reply of THOMAS SPRAGUE, *Commercial Agent of the United States, at La Paz, Lower California.*

When this country was discovered, a cotton-tree was found growing wild in great numbers, over the entire land, and until about 20 years ago, the inhabitants manufactured thread and many other articles for home consumption from the fibre it produced; but the Mexican government then prohibited its manufacture by the people, for the sake of the duties which might be obtained on imported articles. If any attention were given to collecting cotton from these trees, many millions of pounds could be gathered every year; and, by trimming the tree and watering it during the dry season, the qualtity of the fibre might be much improved.

It is my opinion that the Sea Island cotton of the United States can be grown to great advantage here, and that the lands of this territory are unsurpassed for producing sugar, rice, coffee, and grapes. Although the latitude of this place is but 24° north, the climate is so happily tempered by sea breezes, that labor can be performed by any race of men without inconvenience or detriment to health.

Reply of J. P. GAURCHÉ, *Consul of the United States, at Matanzas, Island of Cuba.*

No cotton is cultivated on this island, except a small quantity grown on a few plantations at the southeast end of it, which is all applied to domestic uses. Thirty-five or forty years ago, attempts were made by emigrants from the United States, but with little or no success; and since that time, the gradual rise in the cost of labor here, and the gradual depression in its value in our own country, have deterred the most sanguine from the prosecution of this branch of industry. Labor and capital always seek their highest reward, which, no doubt, will continue to be found in the cultivation of sugar-cane and tobacco, for which this island is so admirably adapted. Another obstacle also exists in the fact that the soil generates a worm which attacks the cotton-plant and destroys the greater

part of the crop almost every year. This worm is said to infest the plantations of our Southern States, but its ravages there are represented to be trifling in comparison with what they are here.

The indigenous cotton-plant of Cuba affords but a very short fibre, and the quality is but temporarily improved by substituting the varieties cultivated in the United States.

Reply of SPIRIDION LADICO, *Consul of the United States, at Port Mahon, Island of Minorca.*

No cotton is cultivated in the Balearic Islands. A cotton manufactory of fifty-horse power is in operation on the Island of Majorca, and another of a hundred-horse power will be at work at this place in 1857, the buildings for which are now in progress of construction.

The cotton used at Majorca is the New Orleans, which will likewise be employed at Mahon.

Reply of F. W. BEHN, *Consul of the United States, at Messina, Island of Sicily.*

Four different species of cotton are cultivated on the Island of Sicily, the *Gossypium herbaceum;* the *G. hirsutum;* the *G. peruvianum*, called also the *G. religiosum*, the seed of which is said to have been originally imported from Africa and Spain; and the *G. barbadense*, the seed of which is purchased at Malta, and has to be renewed annually on account of its tendency to degenerate. American cotton-seeds have been tried, but the fibre produced from them will not mature. The G. hirsutum and the G. barbadense are annual, and the G. herbaceum and G. peruvianum are perennial. The G. barbadense is the species most generally cultivated, and the most profitable.

The culture of cotton has prevailed here from an unknown period, and the seeds have always been procured from Spain, the Barbary States, and Malta. The fibre of all the varieties named, except the G. barbadense, has greatly deteriorated in length, strength, and uniformity, and the quantity diminishes yearly in the ratio of the increase of the seeds; but, in consequence of the annual renewal of the stock of the G. barbadense, no impairment of its good qualities has been observed since its introduction.

The annual product of Sicily is from 1,750,000 to 2,000,000 pounds. From 500,000 to 750,000 pounds are exported to Naples for the manufactories of Castel-a-Mare di Stabbia. All the rest is spun on

the island, and manufactured into light-brown shirtings, a portion of which is afterward printed. The usual price of ginned cotton is from 14 to 15 cents a pound. Wooden rollers, manufactured in Sicily, are the agencies employed in ginning, and the product of fibre is nearly equal in weight to the seeds, say, averaging between 45 and 50 pounds in the hundred. The packing is done by hand or by wooden presses. A bale, by the former means, contains about 300 pounds, and by the latter, 375 pounds. The cost of production, including ground rent, is estimated at 12 cents a pound.

The soil and climate are well adapted to the production of cotton, particularly on the southeast part of the island, and within 20 miles of the sea. Further in the interior, the heat is not sufficient. In the region named, during the cotton-growing months, that is to say, from May to October, the minimum temperature may be set down at 61° F., the maximum at 77°, and the mean at 69°. The quantity of rain which falls during these months, I cannot ascertain, but it is generally sufficient.

The ground is not ploughed for cotton, but dug 18 inches deep with a kind of spade, four or five times during the period between November and May; the seed is then planted, and nothing more is done afterward, except to keep the ground clear of weeds. No other than stable manure is used on this island, and even this is not applied in preparing the soil for the culture of cotton. The seeds are planted between the 1st of May and the 15th of June; the plant flowers in July, August, and September, and the cotton is gathered in the latter part of September and during the month of October. The usual yield to an acre is from 1,150 to 1,200 pounds. The value of cotton-land is from $150 to $175 an acre; its annual rent is from $20 to $25 an acre.

As physical causes injuriously affecting the cotton-crop, the long-continued north winds may be named, but happily they do not often occur in the cotton-growing region. Caterpillars and ground-worms also occasionally do some injury. The political and social condition of the country might not be regarded as adverse to this department of industry but for the indifference and apathy manifested among the people, who pursue the same modes of cultivation and preparation of cotton that were practised by their fathers at the beginning of the present century.

From information derived from various sources, it appears that from 2,100,000 to 2,500,000 pounds of cotton-yarn; 75,000 to 80,000 pieces of brown, white and bleached shirtings and domestics, of 37½ to 40 yards each; 100,000 to 120,000 pieces of cotton prints, of 24 yards each; and 120,000 to 150,000 dozen of printed handkerchiefs are yearly imported from England to Messina. The importation from France is from 18,000 to 20,000 pieces of domestics, shirtings, and prints. From Switzerland the importation is very small; and from the United States no manufactures of cotton are imported.

The fact last stated is to be regretted. The United States compete with England in most parts of the world, and should endeavor to do so here. More than $2,000,000 are annually paid by American

importers for Sicilian produce. In the payment of this large amount, these importers, for the last two or three years, have been subjected to a loss of from 12 to 15 per cent. on exchange, which might have been obviated by a direct interchange of commodities.

Palermo receives from England and France cotton goods to the amount of about one-fifth of what is imported at Messina. The other ports of Sicily make no importations of cotton goods, but draw their supplies from Messina.

Nearly all the domestics, shirtings, &c., manufactured in Sicily, have been woven by the poor, upon old-fashioned looms, in their own houses. Only four small weaving establishments exist on the island, two at Messina, one at Catania, and one at Palermo; and two printing establishments, one at Messina, and one at Catania. The building of a large spinning and manufacturing establishment, with steam as the motive power, is now, however, in contemplation.

None of the cotton goods imported or manufactured on this island are exported to foreign conntries ; but a large proportion, particularly of prints, fabricated in Messina, are sent to Naples; and the southwest part of Calabria is entirely provided from this port.

The import duty on cotton yarn is about 27 per cent. on its average value ; on brown, bleached, and unbleached domestics and shirtings, about 60 per cent.; on prints, about 65 per cent. The duty on raw cotton, of which, however, none has ever been imported, is $8 25 cents per Neapolitan cantar of 192 pounds, or more than 4$\frac{1}{5}$ cents a pound.

Reply of ALEXANDER HAMMETT, *Consul of the United States, at Naples.*

The cotton (Gossypium herbaceum) cultivated in the plains near Castel-a-Mare, Angri, Scafati, and Nocera is a small plant of an annual variety similar to that of the United States. Its culture is attended with such advantages as to induce the formation of various projects by companies to extend it, none of which, however, have been carried into execution. It has received some attention from the farmers for more than a hundred years; but, under the Berlin and Milan decrees of Napoleon, its product increased rapidly, and the price rose to $1 a pound, though it had to be sent by land to Lombardy, Switzerland, and France. Its culture has since declined. I have not been able to learn whether the French introduced seed, or merely continued the species they found here.

The fibre has not deteriorated, either as to length or strength, but has rather improved. The annual product is about 2,000,000 pounds. In the southern part of the Island of Sicily, the cultivation is greater than in Naples. In former times, small quantities were shipped to Marseilles, but since manufactures have increased here, it has been all consumed in this country. The most extensive

manufacturing firm imports annually from the United States two moderately-sized cargoes, besides smaller importations indirectly obtained thence. Much cotton twist is also imported from England. There has been some improvement in the fabrics produced here, but they are still far from offering any inducements for exportation.

Ginned cotton usually commands from 14 to 15 cents a pound. The cultivation is protected by a duty of $8 per cantaro grosso of 196½ pounds, if introduced direct from the United States; and $16, if indirect, or a little more than 4 cents a pound in the former case, and 8 cents in the latter.

The cotton raised here is ginned both by roller and saw-gins, and yields 33 per cent. of fibre. The gins are made in the country. The packing is performed with the hands and feet, and the bales are not of uniform weight. The cost of production of each pound of fibre is from 10 to 12 cents.

The soil and climate are well adapted to the profitable culture of cotton. The thermometrical indications of the weather in the sun are usually as follows:—

Months.	Minimum.	Maximum.	Mean.
May, ...	75°	80°	77½°
June, ...	80	100	90
July, ...	100	112	106
August, . . .	100	112	106

Little or no rain falls in the cotton-growing months, and recourse is therefore had to artificial irrigation.

The seed is planted in rows, between which channels are made for the flow of water drawn from wells. I am not aware that any other than stable manure is employed. The planting is performed in April, the flowering takes place in June, and the cotton is harvested in September, October, and November. The product of fibre to an acre is about 200 pounds, but some other crop, of less value, is also grown upon the same land. The value of good cotton-land is $450 an acre, or more. The rent is from $20 to $25 an acre, but the annual land-tax, paid by the owner, in bi-monthly instalments is from one-fifth to one-fourth of the rent.

The physical causes of injury to the cotton-crop are, the occasional presence of destructive worms, and of mists, or fogs, in July and August. A greater evil, however, exists in the social condition of the inhabitants: The relations between the land-owner and the cultivator are but too often characterized both by the oppressive exactions of the former, and the general bad faith of the latter.

Reply of GEORGE MITCHELL, *Vice Consul of the United States, at New Castle, Australia.*

[Derived from Rev. John Dunmore Lang, D. D., residing at Sydney.]

Although cotton has been cultivated successfully for more than ten years past in various localities along the east coast of Australia, it has scarcely as yet been grown in any locality as an export, although as much as one acre in one instance, and three in another, have been produced. When the growth of cotton would otherwise have been engaged in to a considerable extent, after the favorable result of the earlier experiments had been ascertained, the discovery of extensive gold fields in this and the neighboring colony of Port Phillip, or Victoria, suddenly devoted all the available labor of the country to other pursuits of a more exciting and alluring character. In these circumstances, we are very much in the same state in this country, in regard to the growth of cotton, as the Americans were in about the year 1788 or 1790, when it was cultivated only in small patches, and the product denominated, I think, by Mr. Madison, "garden produce." But many of our colonists are now proposing to engage as extensively as they can in this branch of industry.

We have had specimens both of the New Orleans and Sea Island varieties of cotton grown in Australia, for about ten years, the former from seed obtained of Mr. Bayley, of Manchester, and the latter from seed imported from the United States. The mildness of our winters renders all varieties perennial. The New Orleans variety seems to be the most productive in point of quantity, but the Sea Island would unquestionably be the most profitable. Improvement, rather than deterioration, has been realized in both within this period. With respect to the aggregate product, the export, and the manufacture of cotton, the operations have been so limited that statistics of this nature have not been regarded as of practical interest. The roller-gin is believed to be the best adapted to the finer descriptions of cotton, and is probably the only kind in use. One, constructed by Mr. Longlands, of Brisbane, has been approved.

The soil and climate of Australia, for about 700 miles along the Pacific, from the 36th parallel of south latitude, northward, are admirably adapted to the growth of cotton, and especially of the Sea Island or finer descriptions. All that is requisite for the purpose, is a numerous agricultural population from the mother country on the many tidal rivers which occur, upon an average, every 50 miles along the coast. The climate is of unsurpassed salubrity. We have slight frosts in the winter months, but not sufficient to kill the cotton-plant. In summer, the thermometer rarely exceeds 80° F., although it sometimes reaches, and even exceeds, 100° during the hot winds we have from the northwest three or four times a year, for from twenty-four to twenty-six hours at a time. At all other times, the nights

are remarkably cool and pleasant, even in summer. The cotton-plant stands the heat and drought remarkably well. In our summer months of December, January, and February, the plants are in flower; the first frosts occur in April; and the cotton-harvest may be said to extend from January till May. The product of an acre at Ipswich, Moreton Bay, was 920 pounds of Sea Island cotton in the seed, valued at 25 cents a pound cleaned, when it was supposed that it would weigh 300 pounds. The finest land can now be purchased at $5 an acre, but the price rises with the influx of population. The best season for planting has not yet been determined. For ten years, the fall of rain has been nearly 50 inches per annum on this part of the Australian coast. From 200 to 500 miles further north, it averages about 70 inches. But the climate all along the coast is remarkably dry, notwithstanding, and to this is attributed its great salubrity. The alluvial land is too rich to require manure for any branch of cultivation.

Nothing indeed is as yet known of physical influences adverse to the culture of cotton. Not only is it true that the frost is harmless, but that insects of any kind do not affect the crops. An adequate laboring population, alone, is needed to induce the extensive and profitable culture of the plant. At present, it can only be grown by small farmers on their own account, and is ginned at a central establishment in each district. With an increased population, such as is likely to be introduced at an early day from the mother country, cotton may be grown profitably, and to any conceivable extent, all along this coast.

Reply of John Ralli, *Consul of the United States, at Odessa, Russia.*

Cotton is not cultivated here, nor in any neighboring district; neither are their any manufactories of cotton in Southern Russia. The small quantity imported at Odessa from Turkey and Macedonia is used as wadding in the manufacture of bed-quilts and winter clothing.

Reply of Nicholas Pike, *Consul of the United States, at Oporto, Portugal.*

The cotton-plant is not cultivated as an article of commerce in the kingdom of Portugal; but it may be seen growing in the botanical gardens at Coimbra, and in a few of the gardens of the wealthiest nobility. The raw article is received principally from America, and the manufactured, from Great Britain.

The quantities of raw and manufactured cotton imported into Oporto, in 1855, were as follows:—

CLASS OF GOODS.	Quantity.	Value.	Duties.
	Pounds.		
Raw materials, - - -	1,911,451	$197,872 72	$411 93
Yarn, - - - - - - -	1,213,157	171,817 07	61,142 84
Velveteens and cords, -	205,199	101,971 26	20,073 74
Muslins, - - - - - -	68,140	70,751 04	18,669 69
Dimities, - - - - - -	3,518	3,960 84	1,687 05
Calico, - - - - - - -	33,935	16,503 24	5,729 00
Cotton velvets, - - -	36,710	31,872 80	7,684 93
White, - - - - - - -	581,240	177,572 72	41,467 61
Unbleached, - - - -	2,070,745	410,393 27	93,936 40
Colored, - - - - - -	570,028	330,941 04	145,939 14
Other articles, - - -	3,331	2,988 02	836 80
Total, - -	6,697,454	1,516,644 02	397,579 13

Reply of F. W. CRAGIN, *Consul of the United States, at Paramaribo, Dutch Guiana.*

Gossypium herbaceum is regarded by the most approved authorities, and G. barbadense by others, as the variety of cotton best adapted to cultivation in Dutch Guiana. It is here perennial, affording a crop every six months, and continuing to yield until four or five years old. It has been cultivated here since 1706, and the origin of the seeds at that time is unknown. No deterioration has been experienced in the varieties grown, but the Sea Island cotton, obtained from the United States, soon degenerates in consequence, it may be, of being planted within the reach of their influence.

In 1786, the first exportation was made, amounting to 600 pounds; in 1794 [?], the exports reached 1,000,000 pounds; from 1816 to 1855, both inclusive, the average (being the whole crop each year) was 1,382,182 pounds, the largest, 2,719,083, being in 1821, and the smallest, 350,860, in 1846. For the last five years, the export has been as follows:—

	Pounds.
1851, - - - - - - - -	965,537
1852, - - - - - - - -	1,183,015
1853, - - - - - - - -	677,705
1854, - - - - - - - -	606,464
1855, - - - - - - - -	1,036,309
Total, - - - - - -	4,469,030

the average being 893,806 a year. The entire product was exported to Holland until 1848, since which period, England has received a portion of it by direct importation. The price of saw-ginned cotton has cf late been from 30 to 32 cents a pound, Dutch, or from 12 to $12\frac{2}{5}$ cents United States, currency, roller-ginned cotton bringing a trifle more. In 1853, six of the largest plantations used saw-gins, made in England and the United States, propelled by steam-power, and twenty-six smaller plantations worked roller-gins, made in the colony, by hand or foot-mills. About 30 pounds of clean are usually obtained from 100 pounds of cotton-seed. It is packed in bales of 330 pounds, by means of screw presses. Respecting the cost of production, no positive information can be obtained.

In regard to the climate, the following table may be relied on as authentic, and as representing other years:

Observations with the Psychrometer of Professor August, made in 1842, at Paramaribo, by F. A. C. Dumontier.

Months.	Dry-bulbed thermometer.	Wet-bulbed thermometer.
January, - -	78.98° F.	74.66° F.
February, - -	78.26	74.66
March, - -	78.98	75.20
April, - -	79.34	75.56
May, - - -	79.52	76.10
June, - - -	77.90	75.20
July, - - -	79.88	75.74
August, - -	81.86	76.28
September, - -	85.82	76.64
October, - -	81.68	75.38
November, - -	80.60	77.18
December, - -	78.44	75.74
Mean, - - -	80.11	75.70

The greatest difference observed in the thermometer, within twenty-four hours, was 26°; the highest point attained in the shade, 96°; the lowest, 70°, which latter was observed just after sunrise.

All the land on the sea-shore is well adapted to the profitable growth of cotton. It is usually found heavily wooded; but, being cleared, is drained by large trenches and sluices, and subdivided by smaller trenches into beds from 20 to 60 feet wide, and of suitable length. It is then dug and turned by the hoe, the application of the plough being impracticable—when the seeds are planted in hills 4 to 6 feet apart. The plants are thinned in six or eight weeks and hoed twice. No manure is used, the exhausted land being abandoned and new land taken into cultivation; or, in some instances, the old land is put under sea-water for from one to four months, and then redeemed and replanted. This submersion leaves a coating of fine mud.

The seeds are planted in April and May; the plants commence flowering in the latter end of July or early in August, and continue till the crop is in. The picking, or "plucking," as it is here termed, usually commences in October, and, in favorable seasons, lasts for several months, sometimes until May; but the principal crop is secured in October and November. The usual yield to the acre is from 150 to 200 pounds. The price of land depends entirely upon the value of the improvements made upon it, as any reasonable amount may be obtained from the government, without other expense to the recipient than such as a petition and the conveyancing may call for. Land is never rented.

The "chenilla," (Noctua xylina,) and, within the past twenty years, a white insect, at first taken for mildew, are both injurious to the plant; but severe droughts, and heavy and long-continued rains, especially in October and November, are still greater disadvantages to this culture. The adaptation of the soil is such, however, that there can be little doubt that the yield per acre would average 1,000 pounds, could scientific culture be applied with a competency of laborers; and hundreds of thousands of acres now lying waste might thus be brought into profitable use.

Reply of ROBERT G. SCOTT, JR., *Consul of the United States, at Rio de Janeiro.*

All kinds of cotton can be cultivated to advantage in the Province of Rio de Janeiro, whether annual or perennial varieties; but the small quantity that is produced is almost exclusively tree-cotton, of the introduction of which there is no record. Its seed, however, no doubt came originally from Asia. The general character of the fibre is long, strong and somewhat coarse. Whether it has deteriorated or not, it is impossible to say. The quantity produced is so limited that no account is taken of it; nor is any of it exported. The quantity manufactured here does not probably amount to 500,000 pounds a year. There is only one factory in the province, and it manufactures very coarse and heavy cloths, for bagging and negro wear.

Good ginned cotton generally rules at from 200 to 250 reis per pound, or say, about 12 to 13 cents of our currency. It is nearly all imported from Pernambuco, Bahia, and other northern ports of this empire. It is ginned mostly by roller-gins; saw-gins are also used; but much cotton is still ginned by hand. A hundred pounds of unginned cotton produce from 25 to 30 pounds of ginned cotton, and sometimes even more, when the saw-gin is used. These gins all come from the United States; but the roller-gins are made where the cotton grows. That brought from the northern parts is very badly packed by screw press into bales of from 120 to 160 pounds.

The cost of production of a pound of fibre well ginned cannot be accurately determined, where no plantation is regularly devoted

to its culture; but the usual calculation is, that one negro can cultivate 2,000 hills of cotton, producing about 700 pounds, when ginned.

The soil and climate are finely and perfectly adapted to the growth of cotton. The thermometer ranges from about 60° to 95° F. the whole year round, and cotton bears more or less nearly all the time. Respecting the quantity of rain which falls during the year, I can only state that it is sufficient for the cultivation of cotton.

The mode of cultivation is as follows: The land is first cleared of wood and underbrush, which is burned where it falls; then, the ground is hoed up into hills, about 7 feet apart, in each of which 7 or 8 seeds are placed. In ten or fifteen days, the seeds sprout, and, when the young plants have attained some strength, 4 or 5 of the weaker ones are rooted up and thrown away, leaving 3 or 4 plants in each hill. In from 6 to 8 months, they yield the first crop of cotton; and they continue to bear well for five or six years, provided they are properly trimmed, and the ground cleared from weeds, &c., once or twice a year. When the cotton is planted, it is usual to plant or sow rice, beans, pumpkins, or other crops in the spaces between the hills. Even Indian corn is so planted, and with advantage, on account of the shade it affords to the young cotton-trees. Of course, this is only done when the cotton is planted, as in a short time, the tree attains the height of 12 to 15 feet, and, if the soil is good, the trunk often grows to 4 inches in diameter, and naturally branches out in proportion. No manure of any kind is used for the cotton-crop, nor anywhere, indeed, except in gardens and lots for grasses. The seeds are generally planted in November; the plants flower mostly in June, but they open freely almost all the year; the bulk of the harvest is in September and October, but cotton is picked, also, nearly all the year. The product per acre, and the value of cotton-lands, cannot be well determined, because of the limited experience in this department of culture.

The causes which operate against this branch of industry are: 1st, habit of routine, which induces the planter to cultivate coffee rather than anything else, because his father and grand-father did so before him, and because all of his neighbors do so now, and he dislikes innovation and change, and sees no market for a cotton-crop. 2d, habits of idleness, want of energy and enterprise.

No cause, physical, political nor social, except such as have been named, so far as I am aware, operates injuriously to the cultivation of cotton in this empire.

Reply of J. STONE, *Consul of the United States, at San Juan de los Remedios, Island of Cuba.*

The lands of this section of this island are equal to the best on Red River, or the Mississippi, for the growth of cotton, and the plant stands for years; but the cultivation of it is unknown.

Reply of ROBERT H. LEESE, *Consul of the United States, at Spezia, Italy.*

During the occupation of Italy by the French, under the first Napoleon, it was one of his projects to introduce the cultivation of the cotton-plant; but it failed generally throughout Northern Italy, and now is not known therein, nor, I believe, further north than in some of the Papal States.

The principal agricultural products of this portion of Italy are simply the olive and the grape, with which the whole face of the country is covered, even to the summits of seemingly inaccessible mountains. The latter are cultivated by means of terraces constructed at great expense of capital and labor. The trees are planted in dense groves, and require but little care.

Reply of AUGUST BELMONT, *Minister Resident of the United States to The Hague, Netherlands.*

The species of cotton most in cultivation in Surinam, a colony of the Netherlands, is *Gossypium arboreum*. *Gossypium vitifolium*, and *Gossypium hirsutum*, were formerly much cultivated, but are not so now. They are all perennials.

The period of the introduction of the cotton-plant into Surinam is not known, nor the place whence it was obtained. Mention is made of its culture as far back as 1735, since when, it has been regularly grown, without experiencing any deterioration.

The annual product is about 1,105,000 pounds, two-thirds of which are exported to the Netherlands, and one-third to Great Britain.

The saw-gin and roller are both used, the former being imported from England and the United States, and the latter made in the colony. From 30 to 40 pounds of fibre are usually obtained from 100 pounds of seed-cotton. It is packed into bales of 331½ pounds by means of a screw.

Both the soil and climate are considered favorable to this culture, but especially on the sea coast. The usual range of Fahrenheit's thermometer throughout the year may be stated as follows:—

Months.	Maximum.	Minimum.	Mean.
January, - - - -	89°	79°	79°
February, - - -	89	77	78
March, - - - -	89	83	79
April, - - - - -	89	83	79
May, - - - - -	90	87	80
June, - - - - -	86	80	80
July, - - - - -	97	80	84
August, - - - -	94	79	83
September, - - -	91	77	82
October, - - - -	91	76	82
November, - - -	92	82	82
December, - - -	88	71	78

The quantity of rain within a single year has been ascertained to be as follows:—

Months.	Inches.	Months.	Inches.
January, - -	10.79	July, - - -	9.40
February, - -	9.66	August, - -	4.71
March, - - -	10.37	September, - -	2.00
April, - - -	9.70	October, - -	2.01
May, - - - -	15.24	November, - -	3.67
June, - - -	12.46	December, - -	9.54
		Total, - - -	99.55

The seeds are generally planted in December, in rows, 6 or 7 feet apart, ten or twelve being deposited in each hole, when they are covered loosely with earth. The pruning is done in April and May, a ninth of the plants being thus renewed every year. Manure is never employed. When the richness of the soil is consumed, new land is brought into cultivation, and the old abandoned. The plants flower twice a year, nine months after planting, in January or February. The cotton is harvested from September to December, and in February and March. The average yield is about 442 pounds to the acre. The value of land is estimated in proportion to the number of slaves attached to it, as well as to other circumstances. Cotton-lands are never rented.

With respect to causes operating injuriously to the cotton-crops, it may be stated that they are rendered very precarious by the frequent presence of a worm, which is particularly destructive when the buds are forming; and that the laborers are frequently troubled with inflammation of the eyes, caused by the glare of the sun upon the fields.

In the East Indies, cotton is cultivated for export to Europe; and several attempts have been made to cultivate it in Java, (another colony of the Netherlands,) and, although with limited success, the enterprise is still prosecuted by the natives, who cultivate enough for their own use, and export small quantities to China.

Reply of James H. Williams, *Consul of the United States, at Sydney, Australia.*

[Derived from a paper by Dr. Hobbs, of Brisbane, Moreton Bay.]

The Sea Island cotton was introduced into the region of Moreton Bay, from the United States, in 1849, by Mr. S. A. Donaldson, and immediately propagated and distributed to most of the growers by Dr. Hobbs, of this district; and a superior description of this same variety was cultivated in 1856 from seed introduced by Captain W. B. O'Connell, which he had procured from the prize sample in the great Exhibition at London, in 1851.

The cotton-plant is here a perennial, the frost, except in unusually severe winters, not being sufficient to destroy it. Cotton has been picked from the same stalk five years in succession, the fourth year producing the largest crop, a pound of clean cotton being then, in some instances, obtained from a single plant. Coarser varieties have been tried, but the Sea Island is decidedly the best, and no deterioration has been experienced since its introduction.

Respecting the total product of Moreton Bay, the amount exported annually, and the quantity manufactured, there are no data upon which opinions may be fairly based. In 1853, 26 bales were exported in the seed to England; but it is usually picked by hand for exportation, and is then valued at Manchester and Glasgow at from 1*s.* 9*d.* to 2*s.* 6*d.* per pound.

About 25 pounds of fibre are obtained from 100 pounds of unginned cotton. Roller-gins alone are regarded as adapted to this variety; and, when the product increases, it will be packed in bales of 300 pounds each, by means of screw presses. It is usually estimated that the cost of cultivating an acre of cotton is from £7 to £10. The yield is a bale of 300 pounds of clean cotton, worth £20, thus leaving a profit of £10.

Both the soil and climate are believed to be admirably adapted to the profitable growth of this crop. Thermometric indications of the cotton-growing months may be given as follows, according to Fahrenheit's scale:—

		Maximum.	Minimum.
1853,	September, - - - -	86°	49°
	October, - - - -	90	50
	November, - - - -	96	62
	December, - - - -	98	66
1854,	January, - - - -	106	72
	February, - - - -	96	68

the maximum being taken at $1\frac{1}{2}$ o'clock, p. m., and the minimum at 10, p. m. A mean average, taken at 9, a. m., in the shade, given by Captain Wickham's tables, is as follows: September, 64°; October, 66°; November, 76°; December, 78°; January, 76°. The usual fall of rain in these months is as fallows: September, from 2 to 3 inches; October, 1 to 2; November, 1 to 5; December, 4 to 5; January, 2 to 4; February, 3 to 4 inches.

The plough and the hoe are used in the cultivation of cotton; the rows are 6 feet apart, the distance between plants in the same row, 5 feet. It is thought best, after each crop, to trim the tree, leaving only one or two straight stems about 3 feet high. Manure has not yet been required; when it shall be, the salt-water mud of the rivers will be applied. The seeds are planted in September and the early part of October; the plants are in flower in the latter part of December; the cotton-picking commences, in the first year of its growth, in the last week of February, and, in the second and subsequent years, one month earlier, and continues until June.

The usual yield of an acre is from 1,000 to 1,200 pounds in the seed, or 250 to 300 pounds cleaned. The value of cotton-land is £1 per acre. Very little is rented, and none for the cultivation of this crop.

The physical and social causes operating injuriously to the cotton-crop may be very briefly defined. The climate, as has been stated, is extremely propitious, the picking season extending over four of the coolest months. Insects do not injure the plants much, although the "cotton-bug" has been seen among them. Nature seems to have designed this portion of the world for a cotton-field of the most gigantic dimensions. From the Clarence River to Port Curtis, on the coast line, and to a parallel of 100 miles inland, cotton has been and can be grown. The number of streams navigable, both for large and small craft, on the banks of which the land is of the most luxuriant description, is truly astonishing. Between Clarence River and the north bank of Moreton Bay, a distance of about three degrees of latitude, are the following rivers: Richmond, Brunswick, Tweed, Parry, Barren, Arrowsmith, Logan, Pine, and Caboolture, besides innumerable creeks of considerable magnitude. The absence of a local government to direct the industry of the people is a barrier to the general culture of cotton. In the absence of such fostering care, agriculture has been much neglected; and the settlement of lands far in the interior has been encouraged by a legislature 500 miles away. Had agriculture received its due share of attention, the

Moreton Bay district might now, at the end of the fifteenth year of its existence, be exporting produce to the value of £1,000,000, or nearly twice the amount of its present product. The Surveyor General, who is 500 miles away from us, is, of course, without accurate information in regard to the lands he directs to be surveyed; and hence, the most thickly-timbered land, the clearing of which would cost about £20 an acre, has been put up at public sale, while the more clear lands, suited for cultivation, remain to this day unsurveyed and unsold, and tenanted only by the kangaroos.

In searching for a reason for this apparent indifference, it has been conjectured that the government at Sydney does not wish to be appealed to by the people of Moreton Bay for native police to protect them from the blacks; and yet the disposition to encourage and protect sheep-husbandry in the most liberal manner in the interior is always manifest. Another disadvantage consists in the fact that, for small farms, such as the cultivator of the soil would buy, a much larger price per acre is asked by the government than for the larger farm at its side, which the capitalist alone can purchase.

The proximity of the gold-fields is also a cause adverse to the culture of cotton; for every report of a "lucky find" tends to unsettle the minds of the working men, and to render the supply of laborers precarious, and thus deter thrifty agriculturists from enterprises requiring persistent application and a dependence upon the labor of others, for the realization of profit. How the introduction, by the hundred, of "ticket-of-leave-men," who are now brought in dozens from the Cockatoo Islands, and the application of their compulsory labor to this branch of industry, would operate in this behalf, is yet an unsolved problem.

The separation of this from the other colonies, which has been hopefully desired, would doubtless be favorable to the introduction of laborers; but a recent dispatch of the Governor General has cast a cloud over this prospect.

Reply of FRANKLIN CHASE, *Consul of the United States, at Tampico, Mexico.*

Although the Indians of this country were engaged in the cultivation of cotton at the time of its conquest by Cortez, in 1519, yet, up to the present date, it has not been reduced to any system; and, after diligent inquiry, I find it impossible to obtain such information as will enable me to answer in full the questions propounded in your circular. The following statement, however, for which I am indebted to Mr. Robert Marriner, an English merchant, who is a resident of this place, and has visited every spot mentioned, I trust, will prove acceptable:—

The production of cotton in this country is principally on the coast of Vera Cruz, and southeastward from the capital of the State of that name toward Alvarado, 40 miles distant, and more westwardly toward Tlacotalpan, 50 miles distant from Vera Cruz. The quality of cotton produced here is good, and a little over 75 pounds of seed-cotton yields 25 pounds of fibre. The entire product is consumed by the manufactories of Jalapa, 60 miles northwesterly from Vera Cruz, on the route to the city of Mexico, of Orizaba, 70 miles southwesterly from Vera Cruz, and of Puebla, more remote, westwardly, from Vera Cruz, and but 76 miles southeasterly from the city of Mexico.

From Vera Cruz, latitude 19° 12′ north, to Matamoras, in latitude 26°, notwithstanding the vast extent of territory and its admirable adaptation to the growth of cotton, none is produced, except a little in the neighborhood of Papantla, in latitude 20° 30′, which the Indians cultivate for their own use, and spin in the same primitive manner that their ancestors observed at the time of the conquest, namely, by means of a kind of wooden spindle, the point of which is put in a common wooden bowl, and its gyrations maintained by the fingers. From the yarn, thus spun, they manufacture a narrow cloth.

In the vicinity of Matamoras, cotton is raised in limited quantities, and also in Monclova, about latitude 27°, in the State of Cohahuila, where 100 pounds of seed-cotton are required to produce 25 pounds of fibre. The cotton-crops of these places are consumed in the manufactories of Saltillo, near Buena Vista.

On the western coast, mention may be made of Santiago, between Tepic and Mazatlan, where considerable quantities of cotton are raised, and sold to the factors at Tepic. Further south, between the towns of Colima and Autlan, which are embraced between the 18° and 20° of latitude, and from the line drawn between these towns and the sea-coast, a very rich country is to be seen, in which immense quantities could be raised, were there laborers to attend to its cultivation. As it is, however, sufficient is gathered for the supply of the manufactories of Colima, and some of it even finds its way to Guadalajara, the capital of Jalisco. At Acapulco, on the coast, in latitude 16° 50′, cotton is raised in small quantities, and sent to Mexico, 185 miles northeasterly, to supply the manufactories of that city.

The whole of the Pacific, as well as of the Gulf coast, of Mexico, for about 40 leagues inland, may be regarded as admirably adapted to the growth of cotton, labor alone being wanting. Except on the coast of Vera Cruz, there are few landed proprietors who devote their attention to the culture of this staple, and it is generally produced by small farmers (rancheros) who are content to receive 50 cents for 25 pounds, for their crops, which is about one-half the value ; and these payments are made in advance, usually, in dry goods and groceries, at exorbitant prices. A recent experiment to raise cotton on a farm about 12 leagues from San Louis Potosi, between 6,000 and 7,000 feet above the level of the sea, has been attended with favorable results. An enterprising Spaniard is now

engaged in a similar experiment about 5 leagues from Tula, 40 miles northwesterly from the city of Mexico. His farm is 4,500 or 5,000 feet above the level of the sea.

The mode of culture throughout Mexico, with few exceptions, is simply to put the seed into the ground, and to gather the cotton when ready for picking. The consequence is, that the staple is not long, nor the fibre fine, although it is considered good enough for the manufactories of the country. The plant is everywhere a perennial.

Reply of M. J. GAINES, *Consul of the United States, at Tripoli, Barbary.*

No cotton is ever cultivated in this country. Two experiments have been made by the Pacha since I came to reside here, both of which entirely failed, although the want of rain was supplied by irrigation.

Reply of WILLIAM P. CHANDLER, *Consul of the United States, at Tunis, Barbary States.*

The only species of cotton cultivated here for the purpose of trade or manufacture is a coarse sort, probably indigenous, which is grown to some extent at Bizerta, on the coast, about a day's journey northeast of this city, and also at Sfax, about three days toward the south. In the D'jeereed, the interior bordering on the desert, a coarse natural cotton grows wild, and is not gathered, except in rare instances. The cotton of Bizerta and Sfax is of inferior quality, short staple, and coarse fibre, and is mainly, if not altogether, used for packing, filling, &c.

Sundry experiments in raising cultivated cotton have been made during the present season, (1856,) at the instigation of a celebrated Manchester manufacturer, who visited this country for the purpose last autumn. The seeds used have been Egyptian or American, naturalized in Egypt or Algeria. These experiments seem to be considered decidedly successful. The staple is short, but the fibre is fine and glossy. One specimen which I have seen is very white also. It was grown at Gamart, a bold headland, or lofty promontory, about 15 miles northeast of this city.

The Bey intends instituting some experiments on a larger scale during the ensuing season, and the individuals who have made the experiments of the past season purpose to pursue them further, having obtained American seeds.

The wild and indigenous cottons are probably perennial, the others, annual. The coarse cotton of Bizerta and Sfax has been cultivated to a very limited extent for many years. The annual product is too insignificant to render a conjectural estimate of any value, as also the amount of imported cotton manufactured; nor is the little cotton raised prepared for manufacture by ginning or any other process.

There is every reason to believe that the soil of Tunis is well adapted to the profitable growth of cotton throughout a great extent of the kingdom. The climate is less favorable, there being a want of rain during long periods, sometimes extending to four, five, or even six months. In other respects, the climatic influences, especially the mildness of the winters, may be regarded as favorable. This lack of rain, however, may be compensated by irrigation from wells or running streams, throughout a great portion of the kingdom.

From thermometrical observations, made by myself during eleven months of the year, in the most favorable situations—places not only shaded, but as cool as could be found in the houses where the instruments were kept, protected from the influences of the sirocco winds which so often prevail, and which would increase the temperature from 10° to 15° F., the following table has been compiled:—

Observations made between Sunrise and Sunset.

Months.	Maximum.	Minimum.	Mean.	Remarks.
January, -	58°	49°	53½°	72 observations in 1855.
February,	61	49	59	59 observations in 1855.
March, - -	60	48	58	62 observations in 1855.
April, - -	71	54	60	120 observations in two years—1855–'56.
May, - - -	76½	60	64	120 observations in two years.
June, - - -	84	66	74	145 observations in two years.
July, - - -	85	73	76	24 observations in two years.
August, -				No regular observations. Highest point remembered, 105°.
September,	84	74	77½	71 observations in 1854.
October, -	80	70	78	61 observations in 1854.
November,	72	58½	68½	73 observations in 1854–'56.
December,	64	53	54	64 observations in 1854.

When exposed to the sun, during the siroccos in the summer season, the thermometer has been known to reach 150°. Under such circumstances, an instrument of my own attained 138°, and, being graded no higher, exploded. I have no means of ascertaining the annual fall of rain.

The usual mode of cultivation here and throughout the East is of the rudest kind, there having been little change or improvement, so far as is known, since the days when Ruth gleaned in the fields of Boaz. No fertilizing agent is ever applied to the soil. December, January, and February are probably the most favorable months for planting, and September and early October for securing the cotton wool.

The physical causes operating injuriously to the cultivation of cotton have been recited; but aside from these, the universally oppressive character of the government and its agents would weigh with an almost irresistible pressure upon this as upon all other branches of industry. Enormous taxes and the extortions of subordinate officials retard and cripple the energies of the people in every enterprise. The only hope of the successful culture of cotton must rest upon Europeans, having consular protection, and holding lands under the names of confidential Moorish servants. It is true that the difficulties attending upon cotton-culture everywhere are too great for the energies of this people; yet it may be found that the difficulties peculiar to European agriculture may, to some extent, compensate for those which bear upon the efforts of the unfortunate natives themselves. Nor can the Bey become a large cotton-grower because of the practical impossibility of procuring agents sufficiently honest to allow him a stimulating share of the profits. The sparseness of the population is daily becoming more remarkable, and the paucity of labor hence offers additional difficulties, though the wages for this species of labor are but from 12 to 20 cents per day, without diet.

A very small quantity of cotton is annually imported from Egypt, and from the United States, by way of Malta or Leghorn.

Reply of AMOS S. YORK, *Consul of the United States, Island of Zante, Ionian Republic.*

A single variety of cotton is cultivated at Zante, the name of which I do not know. It is an annual, said to be obtained from Continental Greece, but has existed here from time immemorial.

The annual product of cotton on this island is about 300,000 pounds, the whole of which is manufactured here. Roller-gins of Zante manufacture are used, and 82 pounds of fibre are obtained from 100 pounds of unginned cotton.

The range of the thermometer in the cotton-growing months is from 68° to 93° F., and very little rain falls at this season.

Mixed or vegetable and animal manure is applied to the soil. The seeds are planted in April, the plants flower in July, and the cotton is harvested in August and September. The usual yield to an acre is 200 pounds. Cotton-land is worth from $40 to $160 an acre, and rents for from $2 to $8 an acre.

What is here stated with respect to Zante is applicable to all the Ionian Islands. The culture of cotton is not favorably regarded, in consequence of the scarcity of land, which is everywhere demanded for the culture of the currant, the vine, and the olive, the principal products of the islands.

The cotton fibre required for the annual supply of these places is imported from England.

CULTIVATION OF THE MESQUIT GRASS IN WESTERN VIRGINIA.

BY JAMES A. LEWIS, OF KANAWHA.

In the fall of 1855, I procured sufficient mesquit grass from Texas to sow an acre of hill-land on my farm at "Grotto Dell." On comparing it with the Kentucky blue-grass, orchard-grass, clover, and Timothy, as cultivated on the same farm, I am inclined to rank it the most valuable of them all for this section of country. It seems to stand the climate well, completely covering the ground, and springing up soon after cutting, being less affected by drought than the other grasses. It also remains green during the fall and winter, when it is highly relished by stock. It makes a light hay, however, but is greedily devoured by cattle.

Last fall, I sowed 10 acres more of this grass. I consider it a most important acquisition.

THE RANDALL GRASS.

BY WILLIAM EGGLESTON, OF PEMBROKE, GILES COUNTY, VIRGINIA.

A species of grass was discovered more than 30 years ago on Doe Creek, a tributary of New River, in Giles county, by an old man named Randall Lucas. As the seed differed from that of all other native grasses, he cultivated it for years, selling the seed by the pint, at a high price. By such means, this grass was disseminated in Southern and Western Virginia, and is prized as highly as the Herd's grass (Timothy) and orchard-grass.

The Randall grass may be sown with wheat in the fall, or with oats in the spring, at the rate of a bushel to the acre. It will also do well on fresh, new land which has never been ploughed. As a forage plant, it is more valued for pasture than for hay, being one of the earliest grasses of the spring, and the latest of the fall. The second summer after sowing, it may be mown, and the seed saved, which matures early in July. It usually grows to 18 or 20 inches in height.

HUNGARIAN MILLET.

BY D. B. DIXON, OF MUSCATINE, IOWA.

The Moha de Hongrie, (*Panicum germanicum*,) imported by the Patent Office in 1854, and described in the Agricultural Report of that year, was first grown in this region in Mantua township, Monroe county, and is here commonly known under the name of "Hungarian Grass." It is luxuriant in its growth, and produces hay of the finest quality. Horses and cattle eat it with avidity. Farmers in every part of the country should give it their attention, as it will make more and better feed than any other kind of grass now known in the United States. Our Western farmers, in particular, should learn its value; for its destiny is to change the agricultural products of this portion of the Union, and substitute cows, horses, mules, and sheep in place of hogs. We have raised hogs, heretofore, from necessity, simply because our only reliable crop was corn, and other domestic animals required hay, or its equivalent, which we could not produce with cheapness and certainty.

A good crop of the Hungarian grass is about 3 tons of hay and 30 bushels of seed to an acre, while it will often go beyond, and seldom fall below this. Such crops were grown last season, notwithstanding the drought.

The seed may be sown in this region from the 1st of May to the 15th of June, at the rate of a bushel to 3 acres. It should be put into the ground in the same manner as oats, harrowing before and after sowing. The time for cutting is when the seed is nearly ripe, and the whole plant of a fine yellow color. If cut too early, the seed will not be perfect, and if too late, it will shell out in curing; the stalks will also be too woody. It may be cured in the same manner as other hay. As fodder, after threshing, it is fully equal to Timothy; and when fed out with the seed in, as it generally should be, it is better than good sheaf-oats.

I am sowing, this season, 100 acres of this grass, from which I expect to raise at least 3,000 bushels of seed.

MISCELLANEOUS CROPS.

SUGAR AND MOLASSES.

CHEMICAL RESEARCHES ON THE SORGHO SUCRÉ.

BY C. T. JACKSON, M. D., OF BOSTON, MASSACHUSETTS.

On the 29th of October, 1856, I received from the Patent Office a bottle of expressed juice of the Sorghum saccharatum, procured from plants raised upon the government grounds in Washington. This juice, after being strained through fine linen, had a specific gravity of 1.062; and, after boiling and the separation of an albuminous scum, 1.055. Three and a half fluid ounces of the strained juice evaporated at 212° F., until it became a dense straw-yellow syrup, too thick to run, when cold, gave 217 grains of saccharine matter. That portion of the juice which had been freed from albuminous matter and filtered through paper, gave, on evaporation of a fluid ounce, 78 grains of thick yellow syrup, which, being dissolved in absolute alcohol, left 9 per cent. of mucilaginous substances containing starch. The alcohol took up 69 grains of saccharine matter. This is equal to $14\frac{36}{100}$ per cent. on the juice.

Other portions of the juice were operated upon by lime-water and bone-black, and filtered and evaporated to syrup. A small proportion of crystallized sugar was obtained from the bottom of the vessel, in which the syrup had stood for some days. A part of the juice, diluted with warm water, with the addition of a little yeast, fermented and produced spirit, which, on being separated by distillation, was found to be an agreeably flavored alcohol, having, as M. Vilmorin has stated, a slight noyau taste. Good judges declared that it would make excellent brandy spirit. According to the experiments of Vilmorin, the amount of absolute alcohol obtained from the juice is a fraction over 6 per cent.

On the 3d of November, I also received from the Patent Office two parcels of the sorghum plant, in different stages of ripeness. That with quite ripe seeds was by far the sweetest, while the green one, which was just in flower, contained but very little saccharine matter. One thousand grains, taken from the middle of the ripe stalk, when

peeled, gave 670 grains of pith, from which the juice was separated The latter, on being evaporated to a thick syrup, gave 90 grains of saccharine matter, or 9 per cent. on the weight of the stalk. Another sample gave from $2\frac{1}{2}$ ounces of the pith, 217 grains of thick syrup, or 12 per cent. Thus we have from 180 to 240 pounds of saccharine matter, in the form of a dense syrup, to a ton (2,000 pounds) of the stalks. By means of a screw press, I separated the juice from some of the canes, which had a specific gravity of 1.0987.

Being desirous of ascertaining the saccharine value of the sorghum raised in Massachusetts, I obtained from Capt. R. A. Wainwright, of the United States Arsenal, at Watertown, in this State, five plants, which had been cultivated on the arsenal grounds. Sixteen ounces of one of these plants, nearly ripe, gave $9\frac{1}{4}$ ounces of clear pith, which I exhausted of its saccharine matter by means of boiling, distilled water, and pressure. This liquid, on evaporation, gave 742 grains of thick syrup, too dense to pour from the vessel when cold. The yield of saccharine matter in this case was $10\frac{3}{5}$ per cent.

Another and riper sample, from the same parcel, yielded from 1,000 grains of the stalk 640 grains of pith, and 146 grains of thick syrup, or $14\frac{3}{5}$ per cent. of saccharine matter. On expression, the plant yielded a clear, sweet juice, having a specific gravity of 1.0975.

Analysis of the Bagasse.—One hundred grains, dried at 212° F. and burned in a platinum vessel, left $1\frac{3}{5}$ per cent. of grey ashes. Having thus determined the proportion of inorganic matter in the bagasse, I burned a larger quantity for further experiment. It was found that the ash consisted of the following ingredients:—

	Per cent.
Silicic acid,	14.40
Phosphoric acid,	13.42
Sulphuric acid,	28.70
Chlorine,	3.70
Potash,	8.10
Soda,	9.60
Lime,	11.80
Magnesia,	9.60
Traces of oxyd of iron, a little carbonic acid, and loss.	0.68
	100.00

This analysis shows that gypsum (sulphate of lime) will operate favorably as a fertilizer on this plant; and it is evident that the bagasse ash would serve as a good manure for the crop.

CRYSTALLIZATION OF THE JUICE OF THE SORGHO SUCRÉ.

The sugar of commerce, it is well known, is a crystalline substance principally obtained by evaporating the juice of a gigantic grass (gramen) called "Sugar-cane," which is extensively cultivated for this purpose in regions within and adjacent to the tropics, where the climate admits of advantageous cultivation of the plant; although sugar, nearly identical in character, is manufactured in considerable abundance from the beet-root and maple, in countries of the northern temperate zone; and there is a fair prospect of success in producing an article of equal, if not superior quality, in the same regions, from another gramineous plant, the Sorgho sucré, already introduced. As doubts have been entertained by some as to the susceptibility of crystallizing the latter, the following facts and principles are presented, not only to throw light upon the subject, but to dispel the skepticism of those who are thus willfully or ignorantly groping in the dark.

The manufacture of sugar from the sorgho, as well as from the tropical cane, is beset with difficulties arising not only from the extreme liability and rapid change of the juice from exposure to the atmosphere, as it runs from the crushing-mill, but often from the unripe state of the plant itself. Hence, in order to insure success, it is necessary that the process be conducted under certain conditions of temperature, modes of neutralizing the free acids contained in the juice, and the removal of the albuminous matter previous to evaporation and crystallization.

A fresh, thin, transverse section of ripe cane is diaphanous, resembling a similar slice of an apple or turnip, when seen by the naked eye. Under the microscope, it exhibits a cellular structure, the cells containing a transparent fluid, but presenting no appearance of crystals nor opaque matter. If the slice be dried, it becomes altered in its appearance, being no longer homogeneous, as seen through a common magnifying glass or with the unaided eye; little dots of opaque, whitish matter are visible, protruding, apparently, from the divided longitudinal tubes and transparent cells, as seen surrounding these opaque dots, in which, when placed in sunshine, glittering crystals are observable, which it may be inferred are sugar, formed in consequence of the evaporation of the aqueous part of the juice of the cells. These facts would seem to prove that the saccharine matter of the cane exists in it, in a state of solution, according to the commonly received opinion.

In the manner in which cane-juice is usually obtained by the pressure of rollers, it consists of a compound, not only of what it holds in solution, but whatever it contains in suspension. However care-

fully expressed, it is never at this time transparent, but colored and turbid, in a slight degree. If viewed under a microscope of high power, innumerable granules will be seen floating in the fluid, varying in diameter from 10,000 to 15,000 parts of an inch. By careful filtration through bibulous paper, most of these granules will be separated, and the liquid will be rendered nearly transparent. The matter of which they chiefly consist, it is believed, is of the nature of gluten, and has the power of exciting fermentation, even if kept a year. It is a question not fully determined whether this glutinous matter exists suspended in the juice, when contained in the cells; whether it is separated from the walls of the cells, or is produced by the minute fragments of the longitudinal tubes of the cane, by the pressure employed. It may here be remarked that, besides gluten, there may be other proximate principles suspended in fresh cane-juice, such as starch, gum, wax, &c; but their presence, in the minute quantities in which they occur, is probably of little importance in practice.

As to the question whether the saccharine matter contained in cane-juice is altogether susceptible of being crystallized into sugar, or in part consists of other varieties of sugar, which are not crystallizable, or only so with difficulty, it may be stated that various opinions have been expressed by chemists in this respect. M. Hervey, of France, contends that there is no uncrystallizable sugar in pre-existence in the cane, and that the formation of glucose (grape sugar) or molasses is only owing to the action of the salts contained in the liquid during the manufacturing process. Be this as it may, it is certain that the greater portion of the saccharine matter of the juice is crystallizable, and may be obtained in the state of crystals, if, after rapid boiling and filtering, the clear fluid be quickly evaporated, the latter operation being a condition of absolute necessity in sugar-making, as, by slow boiling, at a temperature of 212°, or even exposure for a considerale time to a temperature below the boiling point, glucose may be formed from the purest crystallized sugar dissolved in water. On the contrary, if the concentrated solution of sugar be heated beyond 230° F., it undergoes alteration, and is changed, at least in part, into uncrystallizable sugar, or saccharine mucilage. When we consider how nearly allied these varieties of sugar are, and likewise how nearly allied in their composition they are to other substances, such as gum, starch, woody fibre, &c., we cannot be surprised either at the conversion of one kind of sugar into another, or into these substances, or at the formation of sugar from them. The above-named substances are chemically *isomeric;* that is, nearly identical in composition, so far as their elements are concerned, and the proportions of these elements, though the substances, gum and sugar, are so different in their properties. These reflections may be applied with as much force to the results obtained in the elementary analysis of various kinds of sugar, presented in the following table:—

	Carbon.	Oxygen.	Hydrogen.	
Cane-sugar, - - -	42.47	50.63	6.90	Gay-Lussac and Thenard.
	42.22	51.17	6.60	Berzelius.*
	42.85	50.71	6.44	Prout.
Grape sugar, (glucose,) - - - - - - -	36.71	56.51	6.78	Saussure.
Sugar of starch,	37.29	55.87	6.84	do.
	36.20	56.75	7.05	Prout.
Sugar of honey, - -	36.36	56.58	7.06	do.
Sugar of manna,	38.53	54.60	6.87	Saussure.
	38.70	54.50	6.80	Prout.
	44.10	49.76	6.13	Henry and Plisson.
Glycerin, - - - - - -	40.07	51.00	8.92	Chevreul.
Sugar of milk, - -	38.82	53.83	7.24	Gay-Lussac and Thenard.
	45.26	48.34	6.38	Berzelius.
	40.00	53.36	6.63	Prout.

In comparing these numbers, it will be seen that cane-sugar, which can be considered as the prototype, may be represented chemically by an atom of carbon and an atom of water; and that the proportion of water increases as the sugar becomes less capable of compact crystallization. Accordingly, the sugar of grapes, of starch, of honey, &c., has less carbon and more water than cane-sugar. The results of the different analyses are also the more discordant as the sugar is less regularly crystallizable and associated with a greater number of foreign substances, as in the sugar of manna and the sugar of milk. And the analysis which exhibits the greatest proportion of hydrogen is precisely that of the sweet matter, (glycerin,) which is procured from the most highly hydrogenated of all these substances, namely, oil and fatty matters.

Although the principles of sugar-making are simple, the practice, as before stated, is beset with difficulties and attended with loss and injury of material, arising from the extreme susceptibility to change of the cane-juice itself. The latter, as it runs from the crushing-mill, is nearly colorless; but a very brief exposure to the atmosphere, in warm weather, hastens decomposition, which, unless checked, rapidly advances, and in a short time converts this sweet-tasted, bland liquid into a spiritous or acescent product, turbid

* The first analysis published by Berzelius differs considerably from this, being carbon, 44.2; oxygen, 49.01; hydrogen, 6.78. Berthollet and Saussure obtained results corresponding with those of Gay-Lussac.

from insoluble suspended matter, and wholly unfit for the purpose to which it was intended to be applied. To guard against this evil, the operator always endeavors to conduct the first part of the process, at least, as expeditiously as possible. But instead of heating the freshly-expressed juice of the sorgho, in order to insure its crystallization, in a large vessel to blood-heat, or upward, and adding a little slaked lime, as is usually the case, to neutralize the free acids, which are always present in the juice of the sugar-cane, the lime should be applied while the liquid is cold, conformably to the method discovered by Mr. Leonard Wray, of London, and recently patented by him in Europe and elsewhere. The lime is employed for the purpose of saturating these acids, which should be done as quickly as possible, in order to restore the gluten contained in the liquid to its original insolubility, so that it may immediately coagulate, and, in this manner, envelope in its volume all those substances consisting of green and gummy matters. Let it be borne in mind, in connection with this process, that the lime will absorb a greater quantity of free acid, and this more rapidly, in a cold than in a warm state, in a similar manner as cold water will dissolve more lime than warm, as stated at page 203 of the present Report. After this proceeding, the liquid is strained through cloths, and then clarified with nut-galls, or other tannic substances, aided by the action of heat, when it is again strained or filtered, and then boiled down to a proper consistency for granulation, conformably to the method patented by Mr. Wray.

In a letter from M. Louis Vilmorin, of Paris, bearing date of April 20, 1857, he says: "The crystallization of the sugar of the sorgho, it seems, should be easily obtained in all cases where the cane can be sufficiently ripened; and, as the proportion of the sugar is an unfailing index of ripeness, it follows that we could always be sure of obtaining a good crystallization of juices the density of which exceeds 1.075, whilst weaker ones could not yield satisfactory results after concentration.

"I attribute this peculiarity to the fact that the sugar is preceded in the juice by a gummy principle, which seems to be transformed, at a later date, for its proportion diminishes in exact correspondence with the increase of the saccharine matter.

"The uncrystallizable sugar, or glucose, undergoes the same change; that is to say, it is more abundant before than after the complete maturity; but its action seems less unfavorable to the progress of crystallization. The gummy principle obstructs it in two ways; for, besides being a serious obstacle to the commencement of crystallization, it afterward renders it almost a matter of impossibility to purge the crystals, if obtained.

"However, as I observed, this difficulty only presents itself in the employment of unripe canes; for, as soon as the juices attain the density of 1.080 and more, they contain but little else than crystallizable sugar, and their treatment presents no difficulty.

"The lime employed, even to a slight excess, is not so detrimental, it seems to me, in practice, as theory would perhaps indicate. Per-

haps, a slight fermentation, which is inevitable, may disengage enough carbonic acid to destroy the uncrystallizable compound formed by its union with the sugar. The fact is, that the best crystallizations obtained have occurred in those experiments in which I feared to have used too much lime."

Subjoined is an extract of another letter from M. Madinier, of Paris, on the same subject:—

"Up to the present time, the making of sugar from the sorgho has received but little attention, in France, owing to the present state of commerce, which makes it much more advantageous to convert the cane into alcohol than into sugar. Aside from this fact, it is certain, that from this plant crystallizable sugar can be extracted similar in every respect to that made from the cane of the tropics. Of this, I entertain the highest conviction, which is supported by authentic, though not very numerous, facts. * * * * * The stalks of the sorgho contain crystallizable sugar, without furnishing a greater quantity of molasses than the cane. An experiment made at Verrières, with Clerget's apparatus, showed the juice to contain 16 per cent. of sugar, of which there were only $10\frac{1}{3}$ per cent. crystallizable, and $5\frac{2}{3}$ per cent. uncrystallizable; yet we can by no means depend upon a result gained from plants grown in the Departement of the Seine and Oise, in a climate altogether beyond the range adapted to the sorgho."

Thus it will be seen that the making of sugar has been much aided by science. It was a philosophical chemist who first introduced the vacuum-pan method into use, by which such facility was given, with a remarkable reduction of the price of the article, to the refining of sugar. It has been by the application of chemical science in France that the sugar from the beet-root, the produce of that country, has been able to compete with cane-sugar, affording a remarkable instance of the conquest, and it may be said, the triumph, effected by science, as the proportion of saccharine juice of that root is only about half as much as that of the cane, and is mixed with substances more difficult of separation, and more injurious in their reaction. Let the same skill, directed by science, be applied to the making of sugar from the Sorgho sucré, and we may reasonably expect the happiest results. D. J. B.

PEAS.

Report of an experiment of nine varieties of Garden Peas, by J. F. H. CLAIBORNE, *of Laurel Wood Plantation, Hancock county, Mississippi.*

	NAMES OF VARIETIES	Time of sowing.	Soil.	Kind of manure used.	Distance of plants apart.	How affected by weather.	When fit for the table.	Quality.
1	Michaux Ordinary Pea, (Pois Michaux ordinaire,) from France,	Dec. 20	Loam, clay, and sand.	Cotton-seed.	4 feet by 1.	Severely injured.	April 2	Ordinary.
2	Michaux Dutch Pea, (Pois Michaux de Hollande,) from France,	"	"			"	" 10	Good.
3	Clamart Pea, (Pois de Clamart,) from France,	"	"	"	"	"	" 10	"
4	Tall Wrinkled Pea, (Pois ridé à rames,) from France,	"	"	"	"	"	" 15	"
5	Tall Skinless Pea, (Pois sans parchemin à rames,) from France,	"	"	"	"	"	" 15	"
6	Daniel O'Rourke Pea, from Germany,	"	"	"	"	Very severely injured.	" 10	" Inferior.
7	Dwarf Mammoth Pea, from England,	"	"	"	"	Injur'd very little.	May —	Superior.
8	Early Emperor Pea, from England,	"	"	"	"	Severely injured.	March 10	Excellent.
9	Sangster's No. 1. Pea, from England,	"	"	"	"	"	" 17	"

NOTE.—These peas were planted at the same time, on the same kind of soil, but not near enough to mix, and manured with decomposed or putrescent cotton-seed, (long stapled.) Our winter and spring were very severe. All the peas suffered materially, except No. 7. This variety, notwithstanding the cold, has a vigorous vine and leaf, and is an abundant bearer. Nos. 8 and 9 may be classed among the best varieties. No insects attacked my peas. This I ascribe to mixing about a bushel of Pride of India berries (*Melia azedarach*) with the cotton-seed put in the drills. Either applied this way, or as a decoction, this is the best protection I know of against insects.

FRUITS, NUTS, AND WINE.

GRAFTING AND BUDDING.

BY JOHN J. THOMAS, OF UNION SPRINGS, CAYUGA COUNTY, NEW YORK.

The art of grafting, although well known to the ancients, is one of the most important and essential of modern improved horticultural operations. It enables us to multiply an individual variety, without a shade of variation, to an unlimited extent. Propagating trees simply from seed, as is well known, never insures the same sort unchanged. The difference between the parent and product may be slight, but there is no certainty, or even probability, of perfect identity. Grafting, on the contrary, being nothing but the extension and multiplication of the *same individual*, gives us, perfectly unaltered, the sort selected. Had we no way of thus increasing individuals, such valuable apples as the Baldwin and Rhode Island Greening, or the Seckel and Bartlett pears, must have been confined to each original or seedling tree; but, instead of this narrow limit, grafting has given us, of some of these varieties, millions of trees in successful growth. These remarks may also be applied to budding, or inoculating, which may be regarded as a modification of grafting.

There are other advantages gained by grafting. One of these is *early fruiting*. A new sort, for instance, if worked on a common seedling stock, may be eight or ten years in coming into bearing; grafted into a large tree, it may bear in a year or two. The same end may be attained by making use of dissimilar stocks. The pear on the quince, for instance, usually bears in half the time required on a pear stock. Trees are also made hardier by being grafted on hardier stocks, as the peach and apricot on the plum; and the half-tender species of the magnolia (*M. conspicua* and *soulangiana*) at the North, are made to endure the winters there by working them on the wild and hardy cucumber magnolia.

The success of grafting always depends on a certain degree of similarity or affinity between the stock and the graft. An apple can never be grafted on a maple, nor a peach on a walnut. As a general rule, varieties of the same species unite most freely; then species of the same genus; then genera of the same natural order, beyond

which the power does not extend. For instance, pears work with perfect facility on the pear, they being of the same species; less freely upon the apple, a different species of the same genus; still less so on the mountain-ash, a different genus of the same natural order; but not at all upon the plum and cherry. But there are many partial exceptions. The pear grows more freely on the quince, which is separated by many botanists into different genera, than upon the apple, which belongs to the same. The cultivated cherry will not grow at all on many of the wild cherries, though they are all species of the same genus.

The ancients erroneously supposed that grafting could be performed between every species of tree and shrub. Pliny speaks of blood-red apples, made so by grafting on the mulberry, and of black roses produced by grafting on the black currant. In another instance, he asserts: "I have seen a tree grafted and laden with all manner of fruits, one bough bearing nuts, another berries; here hung grapes, their figs; in one part you might see pears, in another pomegranates; and, to conclude, there is no kind of apple or other fruit but was to be found there; but this tree did not live long." An ingenious deception, to which this was no doubt similar, is now practised in Italy, for growing jasmins and other flexible plants, on an orange stock, by boring out the orange trunk, and then bringing the small stems through, which soon grow and fill it closely, appearing as if actually growing in one piece. Such a crowded mass of stems soon perish.

Theory of Grafting.

The theory of grafting is simple. A shoot of the desired variety is made, by close mechanical fitting, to unite with the stock or natural seedling, which would bear fruit of no value. When this mechanical union is made, the sap flows up through the sap-vessels, or pores of the stock, into corresponding vessels of the scion, or graft; and, passing on, expands the buds of the latter. The leaves, when expanded, produce or elaborate sap, as fast as it flows into them, and which before was nearly pure water, into the proper juice of the plant, which now contains ample materials for new wood, derived through the leaves. This descends through the inner bark and deposits new layers of wood. This new deposit cements and secures firmly the stock and graft together, and they become one tree.

It was formerly supposed that the material for the new wood was completely formed and finished before it left the leaves; and cultivators were therefore puzzled with the well-known fact that the wood of the stock always retained its distinctive peculiarity below the line of union. For instance, if a Spitzenberg were grafted on a Bellefleur, all the proper juice being elaborated through the leaves of the Spitzenberg, it was naturally expected that the wood formed

all the way down would possess the characteristics of the latter. But this was not found to be the case; and it was ascertained by later physiologists that the finishing process in the formation of the new wood was effected by the cells in the wood and bark of each respective variety; which at once explained the difficulty. This result is shown in an interesting manner, by grafting successively, on the same stock, varieties having bark of different colors. Let the Northern Spy apple, the St. Lawrence, the Early Joe, and the Baily Sweet—varieties with dark shoots—be grafted in successive years, and alternately, with the Sweet Bough, Belmont, Summer Queen, and Yellow Belle-fleur, which have light or yellow bark; the result will be successive rings of dark and light wood; and if a dormant bud, belonging to either of these portions, should start and form a shoot, the shoot emitted would possess fully the characteristics of the particular variety originating it, no matter how many different sorts the descending juice had to pass through on its way from the leaves downward, and no matter what sort might bear the leaves which elaborated the proper juice.

The correctness of this position was corroborated by grafting a red-beet on a white one. The operation was performed when the plants were only a fourth of an inch in diameter; yet, when the root became large, the line of separation between the two colors remained distinct and unchanged, with red above and white below, all the juice being elaborated by the tuft of leaves on the red-beet above.

This general result sometimes appears to be slightly modified. For instance, if a row of Mazzard cherry stocks, in a nursery, be grafted, a part with the Yellow Spanish, and a part with the White Tartarian, the roots of Yellow Spanish will be found in two or three years to have become few, coarse and stout; those of the Tartarian will be fine, numerous and fibrous. Similar apple stocks grafted with the Tallman Sweeting and Yellow Belle-fleur, present not less striking results—the roots of the former being large, and of the latter numerous and thread-like. It has been observed, also, that the bark of stocks, grafted with the Newtown Pippin, becomes in a few years rough and scaly, like the bark of the stocks of that variety.

All these facts are interesting, and are worthy the study of those who wish to learn the influences operating on grafted trees.

Operation of Grafting.

The *scions* are the shoots of the previous season's growth; and are cut late in autumn, after the fall of the leaf, or at any time during winter, or before the swelling of the buds in spring. Very severe winters often injure the young shoots, and it is therefore safe to have them cut and secured in autumn. This remark applies more especially to the plum, but sometimes to the cherry and pear.

Scions are preserved during winter in various ways. They are frequently buried in cellars, in slightly-moist sand, earth, leaf-mold, or peat; and they keep well in this way, if a proper degree of moisture be maintained, and they are not attacked by mice. The moisture should be just sufficient to prevent their shrinking or wilting. They are less injured when a little too dry than when water-soaked. Saw-dust is sometimes used for packing; but it is liable to heat from fermentation; and uniform moisture is difficult to preserve. The writer has never found anything better for this purpose than fine moss, which retains moisture admirably; is not so liable to impart too much water to the scions as the other substances named; and keeps them clean and free from the grit which they get from sand and earth, and which dulls the grafting-knife. When large quantities of grafts are to be used, the scions should be tied in bunches, with bath strings near each end, the name being plainly written on a strip of shingle or lath, tied up with the scions, with the name outside. In cutting the scions, every bunch should be marked as soon as cut, and before a new bundle is commenced, in order to avoid mistakes. When a sufficient number of bunches are prepared, in the way described, they are to be well packed in a box, with moss through every part, and surrounding them on every side; and, in order to facilitate the selection of any one sort, every bunch should have a piece of shingle, or label, projecting from the end, with the name upon it, the bunches being placed on end in the box, so that any one can be withdrawn without disturbing the rest. They should be examined occasionally during winter, to see that the right degree of moisture is preserved. A black lead-pencil applied to a thin coating of white paint forms the best mark; but, if the label is merely wet before writing upon it with the pencil, the writing will be nearly as durable, lasting many times longer than if written dry.

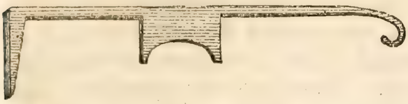
When these conveniences are not at hand, scions may be preserved through winter, with little care, by placing them in a box, open on one side, so as partly to fill it, keeping them in by cross pieces, and then burying the box, open side downward, in a dry spot of ground, and they will come out in spring fresh, plump and sound.

Scions should be of firm, well-ripened wood, from healthy, vigorous trees; and, if the upper portions are pithy, and not fully matured and compact, they should be cut off and rejected at once, as such grafts are not likely to take root, nor will they grow well afterward.

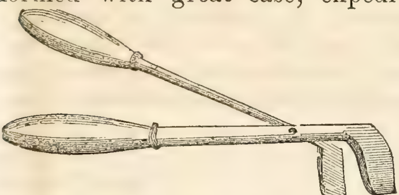
Grafts of more than one summer's growth are only used in rare instances, to produce immediate fruiting, or to secure a variety which may happen to have no young scions. They grow feebly, at least for a time.

The tools for grafting are, two sharp knives, one for the ordinary and rougher cutting, and the other, kept always with a keen edge, for giving the finishing cut and smoothing the faces of the wood and bark which are to come into contact; for it is of great importance that the sap-pores should be smoothly shaved off, and not

scraped asunder. These two knives are sufficient for "root-grafting," or for "whip-grafting," with quite small trees. Those of larger size, worked by "cleft-grafting," require, in addition, a fine saw, a grafting-chisel, or stout knife, and a wedge for opening the cleft. A convenient combination of the two instruments last named is shown in the adjoining cut. It is made of iron and steel, the chisel having a concave edge at the middle, so as to cut the bark smoothly in splitting the stock. The wedge is placed at one end, and the handle and hook for hanging it up, at the other. This tool may be used on stocks several inches in diameter.



When the stocks do not much exceed an inch in diameter, the two operations of cutting down and slitting for the cleft are performed with great ease, expedition, and accuracy, by means of grafting-shears, which save a vast amount of labor, especially such as do much grafting in the nursery-row, with stocks a half-inch or more in diameter. When these shears are opened, and made to embrace a stock an inch or an inch and a half in diameter, motion being given to them with the right hand, while the left presses the stock from the shears, the ease, with which the blade glides through and severs the stock, is astonishing to every one on first trial, being only comparable to the facility of cutting through butter with a hot knife. The cut may be perfectly horizontal, and a dozen or twenty stocks may be excised and prepared for grafting while a single one is severed with a saw. After this, a simple stroke makes a smooth and straight cut to receive the graft.



Grafting-wax is variously made. It usually consists of rosin, tallow, and bees-wax. Sometimes they are mixed in equal parts; but this mixture is hardly adhesive enough; more rosin increases its tenacity. A cheap and useful compound, but sometimes found rather inconveniently adhesive to the fingers, is made of four parts of rosin, two of tallow, and one of bees-wax. A coat of the wax, about one-twentieth of an inch thick, spread over muslin, calico, or tough and flexible paper, makes an excellent plaster for out-door grafting; or, if spread half as thick on paper, is well adapted to root-grafting. In either case, the strips should be narrow, that they may be easily wrapped around the graft till it is well covered, when the rest may be torn off. In making the plasters, it is essential that the ingredients of the wax should be thoroughly stirred together before it is spread. A kind of paper, soft, thin and tough, is now much used by dry-goods shopkeepers for wrapping, and may be purchased cheaply by the ream. For out-door grafting, in cool weather, a lantern or chafing dish is required to soften the plasters.

Modes of Grafting.

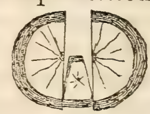
M. Thouin, a French writer, describes a hundred different modifications of grafting; and even Varro, an ancient Roman, mentions no less than twenty. So many ways bewilder rather than enlighten the beginner. It is better to give the reasons on which success depends, with descriptions of only a few of the simplest and best modes of operation. The requisites for success are: 1. A keen knife, to give flat, smooth, unscraped faces for contact. 2. An exact coincidence in the line of division between the bark and wood, both in stock and graft, in some portion of their place of contact. 3. Sufficient pressure to hold the parts firmly together. 4. Covering the wound without completely from wet, and evaporation from within, by a water-tight coating of grafting-wax.

a

b

Cleft-grafting, a very common and simple mode, is represented by the accompanying cuts: Figure *a*, shows the stock cut off, and a cleft made and opened with the wedge, ready for the reception of the graft. The graft is made of a portion of a scion 3 or 4 inches long, smoothly shaved off at the lower end, into the form of a wedge *b*, so as to fit the cleft, as nearly as possible. It is then carefully fitted into the cleft, care being taken that the line between the wood and bark, in the stock and graft, shall exactly coincide at some point, and the longer the line of coincidence the better. The wedge being then withdrawn, the jaws of the cleft close firmly upon the graft, as shown in *c*. A cross section of the union is shown in *d*, which also exhibits the thicker side of the wedge towards the outside, where it should receive all the pressure. Novices often fail to make a good fit, by cutting the wedge on the graft too short, so that the jaws grasp it at their upper ends only, which not only limits the point of contact, but renders the union easy of interruption. When the graft is fitted, the projecting corners of the stock are pared off, as shown by *e*; and every part of the wound is wholly and completely covered with a wax plaster, care being taken to press it

c

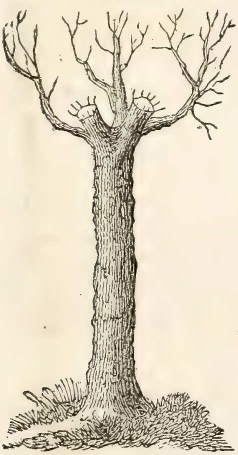


d

e

into the corners with the thumb-nail, so that there may be no portions untouched by the wax, except the cleft itself. The operation is now completed; and the only care subsequently needed is to rub off such shoots as spring from the stock, so as to throw the growth into the graft; and to nip off the side-shoots of the graft, so far as may be required to give it a proper upright direction in growth.

Cleft-grafting is applicable to stocks considerably larger than the graft; and they may be from half an inch to several inches in diameter. This mode is commonly adopted for giving new heads to large trees, which have proved of worthless sorts. This re-heading may be performed advantageously on all large trees which remain healthy and vigorous; but when they begin to become diseased, or decayed from age, it is better to plant young trees. Unskillful attempts at grafting old trees are often made; and one of the worst modes is to train up the large branches and graft into their ends some 10 or 15 feet from the ground. It is next to impossible to gather the fruit safely from such tall, distorted trees. A better mode, though also defective, is to cut off the large limbs near the upper end of the trunk, and graft into the new shoots which are thrown in their place. One objection to this mode is that large wounds are thus made; and another, that the grafts do not grow with much vigor from the small shoots. The best way probably is, to cut off the large limbs, as last mentioned, and, instead of allowing new shoots to spring up around them, to graft immediately into the large stumps themselves, setting the grafts around in a circle, not more than an inch or two apart, as shown in the figures annexed. The grafts thus set into the stumps of large limbs are found to grow with great vigor, and to join each other soon, and cover the whole face of the wound, a part of them taking the lead, and forming new and strong limbs for the renewed tree. In re-topping old trees, in this or any other way, it is important that all the top shall not be removed at once, but that at least three years shall be taken, and about one third of the work performed in each, in order to prevent too sudden a check in growth; and it should be done very early in spring.



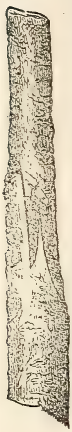
Whip-grafting—sometimes called "tongue" or "splice-grafting," is extensively practised by nurserymen, for root-grafting, and in all other instances where the stock and graft are of nearly equal size.

This mode is represented by the following cuts: Figures *a*, and *b*, are the stock and graft, cut with corresponding slopes, and each with a tongue, which is made above the middle of the slope of the stock, and below the middle in the graft. When these are pressed closely and firmly together, they form the union represented by *c;* and the whole is then covered with a wax plaster. A smoother joint is formed, and the wax is more closely applied, by cutting off a small part of the stock, above the dotted line in the figure, which would otherwise form an inconvenient projection.

a

b

Root-grafting is performed by taking up the stocks in autumn, packing them in a cellar, grafting them within doors during winter, and re-setting them in nursery-rows in spring. It is chiefly used by nurserymen in propagating the apple; and it is not unusual in large establishments to graft two or three hundred thousand in a single year. It does not succeed well with other fruit-trees; though it has been advantageously employed in the Southern States for the peach, which will not grow grafted at the North. The stocks, when taken up, should have most of the tops cut off to save room. This may be done rapidly with an axe, after they are made even, and then packed in boxes in a cellar, with damp moss, or powdered muck or leaf-mould, secure from mice. Two-year stocks are commonly used at the North, when about one-fourth to three-eighths of an inch in diameter; at the West and South, on rich soils, one season's growth is sufficient. If the roots are not more than 4 or 5 inches long, the whole is taken; if they are longer, as more commonly happens, they are cut up into pieces about 4 inches long, each of which has a graft of equal length inserted into it, as shown in the adjoining cut *d*, by the mode already described under the head of "whip-grafting," waxing each with a plaster. The wax may be softer, or contain more tallow, than for stock-grafting, as, in planting out, it is always kept cool beneath the surface of the earth. Root-grafting is performed most rapidly by dividing the labor, one operation preparing, trimming and cutting up the roots and grafts into proper lengths; another inserting the grafts; and a third applying the wax. If the work of joining the two parts is well done, they will hold firmly together, and need no ligatures, which are always detrimental.



c

d

When the grafting is completed, each half day, the grafted roots are packed away in boxes, with moist sand, where they remain until the ground opens. Great care should be taken to mark correctly and distinctly the names of each variety.

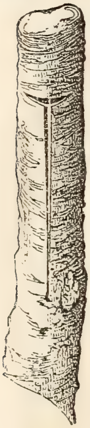
When spring opens, and the ground has been reduced to a fine mellow condition, the grafts are to be inserted by means of the "dibble," represented in the annexed figure, which is made of a spade handle, shod with an iron and steel point. A line for the row is drawn; the tool is thrust into the earth, and a hole made of proper depth; the graft is then placed within it, so that not more than an inch may project above the earth; and then, with the same tool, the earth is pressed up against the root closely on all sides, so as to leave no interstices. The only subsequent care is, to keep the soil mellow and perfectly clean, and to train the trees up to a leading stem. With good treatment, they will grow one to two feet the first summer; and, in fertile soils at the South, double this height.

The season for grafting varies with kinds and circumstances. Root-grafting may be commenced in mid-winter; in large nurseries, it is carried on during the whole winter; but when small quantities are grafted, it is better to defer it till towards spring, as it is easier to keep the grafts in the best condition for a short period. For out-door grafting, the cherry should be worked first; for failure is almost certain, unless the grafts are inserted at least a week or two before the buds show the first indications of swelling. At the North, it is safest to perform the work before the snow of winter has melted from the ground. The plum should also be grafted quite early. The pear and apple will succeed much later; but a larger growth will always take place the first year, if the work is seasonably performed, or before the swelling of the buds.

Trees girdled by mice may be saved by a modification of grafting. With a sharp chisel, about a half or three-fourths of an inch wide, make several incisions around the tree downward into the bark and wood, just below the girdled portions; then make several similar and corresponding incisions, upward into the bark and wood just above the girdled part; into these, fit round portions of apple limbs; with the bark on, sharpened into a wedge at each end. These form a connection between the upper and lower bark, through which the sap flows upward, and the elaborated juice downward; and if these portions are placed thickly around the tree, they soon unite together at their sides, and form a complete tree. The places of union must of course be waxed. Connecting the two separated portions of bark in this way has long been practised; but this particular mode of doing the work by means of a chisel is little known, and is the only one of any value, as it can be done with great expedition. It scarcely ever fails to unite, and the wedge at each end fits in so securely as to be not easily displaced.

Budding, or Inoculation.

Budding may be regarded as a modification of grafting, and consists in introducing the bud of one tree beneath the bark of another, and upon the face of the newly-forming wood. Unlike grafting, it is performed while the stock is in a state of vigorous growth. An incision is made lengthwise through the bark of the stock, with a small cut at right angles across the top, like the letter T, as shown by *a*, in the adjoining cut. The corners of the bark are then turned up as indicated by *b*, so as to admit the bud with facility; and, if the bark does not peel freely enough for the bud to separate it from the wood, as it is pressed in, it must be previously lifted with the budding-knife. The bud is then taken from a shoot of the first year's growth by being cut off with the budding-knife, as shown by *c*, with a small portion of the wood attached, as indicated by *d*, and is pushed downward under the bark as represented by *e*, great care being taken not to bruise nor injure the bud. It is then wrapped closely with a bandage, as shown by *f*, the bud itself being left uncovered; and the operation is completed. The bandage should pass with sufficient force to bring the bark and stock into close contact, the newly-forming wood soon cementing the two parts together. In the course of two or three weeks, the adhesion will be complete; but, at the same time, the ligature will begin to indent the stock, and must be taken off. In the following spring, the stock must be cut down to within 2 or 3 inches of the bud, which will then very soon start and grow; and, when a few inches high, it should be tied up to the stump *g*, to cause it to grow straighter, and prevent breaking off by wind. About mid-summer, the stump is cut off at the place shown by the dotted line, after which, the wound soon heals, and a smooth and handsome tree is formed. If the stock is headed down close to the bud in spring, the bud will either dry up and perish, or suffer for want



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b

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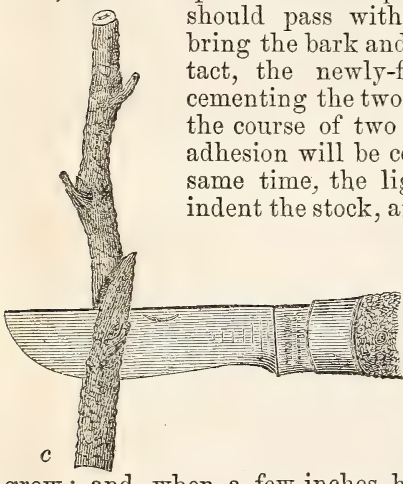

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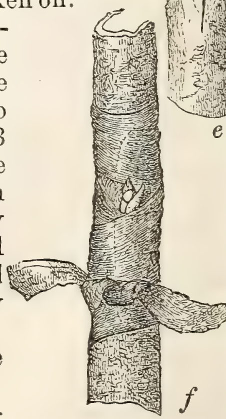


f

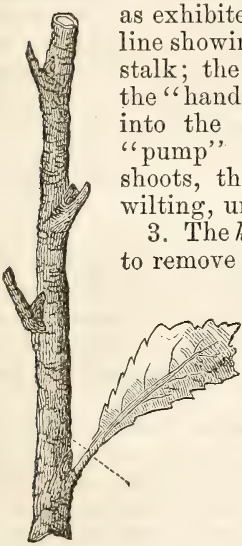
of moisture, and be much retarded. As with grafting, the shoots below the bud must be rubbed off from the stock, as they are formed.

g

There are several requisites for successful budding, namely:

1. The *stocks* must be thrifty, so that the bark will rise freely. This can only happen when they are in a growing state; and success is usually most certain as they approach a cessation of growth for the season.

2. The *buds* must be well developed or ripened, and the young wood considerably hardened; and this rarely occurs until the terminal bud of the shoot has already formed. To keep the buds plump, and to prevent the shoots form withering, the leaves must be cut off the minute they are taken from the tree, as exhibited in figure adjoining, the dotted line showing the place for severing the foot-stalk; the short stump thus left forming the "handle" for the bud while it is pushed into the slit in the stock. As leaves "pump" the moisture rapidly from the shoots, they cause immediate injury by wilting, unless removed.



3. The *knife* must be kept sharp, in order to remove the buds with a flat, smooth face, which should fit the stock with accuracy. The form of the budding-knife is shown on page 324, the edge being rounded, to enable the operator to make an incision near the ground when necessary, and to perform the cut into the stock by a sort of rocking motion, which does the least injury both to knife and stock.

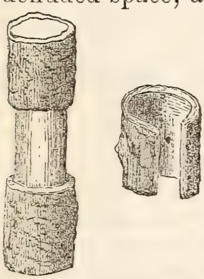
4. The *ligature* must press with sufficient force to bring the two parts in contact, but not hard enough to bruise the bark. If the former is neglected, the bud will not adhere, but will come out; if the latter, the bark will become black and decay. Strips of bast form the best ligatures, and are made, in summer, by soaking freshly-peeled bastwood bark under water for two or three weeks, or by cutting up good Russia mats. Corn-husks are said to be tolerably well in the absence of bast.

5. The *proper time* is a matter of great importance. Some kinds of stocks mature and cease to grow much earlier than others. These, of course, must be budded in time, or the bark will cease to peel. Cherries and plums, at the North, usually require budding soon after mid-summer. Pears and pear-stocks usually require attention nearly as early. Apples follow next; and, lastly, pears on quinces, and peaches, the period for which extends into autumn, because these continue growing for a long time. At the South, the period may often be prolonged some weeks later.

Terminal-budding consists in selecting the terminal bud of a shoot, and cutting the wood sloping below it, inserting it into the stock as in ordinary budding. The bandage must of course be wholly below the bud. It is practised where side-buds are scarce, or where on a feeble shoot they may not be vigorous enough to withstand the cold of winter. It is sometimes used with advantage in propagating the peach from old and feeble trees, the terminal buds being nearly the only ones fit for this purpose.

Spring-budding is performed, late in spring, on stocks which have just expanded their leaves and commenced growing, the buds of the previous year having been kept dormant, till this time, in an ice-house or cool cellar. As soon as the buds have adhered firmly, the stocks are headed down, and they make a good growth the same season. To prevent injury by the increasing hot weather, the buds should be bound in by means of narrow strips of white muslin, which absorbs but little heat; and additional protection by larger strips is useful. Spring-budding has some advantages. Peaches, apricots, nectarines, and mulberries all difficult to propagate by grafting, may be thus increased, and a growth secured early in the season, when circumstances admit of the use of grafts only. Plums may likewise be grown from late-kept scions, which would promise little success by grafting.

Annular-budding is applicable to trees of thick and rigid bark, where the process would be difficult with the ordinary mode, as with walnut, hickory, and magnolia. A ring of bark is removed from the stock, and another corresponding ring, containing the bud to be inserted, and slit open on one side, is made to fit accurately the denuded space, as shown in the annexed cut.



Budding possesses some advantages over grafting. It is a simple operation, and, on a good stock, is more easily performed by a novice. It is the best way to propagate the peach and nectarine, grafting rarely succeeding, except in the extreme South. It is more rapidly performed, at a season not crowded with the labors of transplanting. It admits of repetition, in the same summer, in cases of failure, the stocks remaining uninjured. But it requires more subsequent care and labor, in removing ligatures, heading down, tying up, and pruning.

The number of grafts or buds inserted in a day, by a skillful workman, varies somewhat with the condition of the stocks. Of root-grafts, seven or eight hundred may be set in a day, with an active lad to assist by applying the plasters. Five or six hundred may be set out of doors, with the same assistance, if the stocks are in fair order, by means of the grafting-shears already described. When stocks for budding peel quite freely, and the buds are cut and prepared to band, twelve to fifteen hundred a day are not an unusual number, an assistant tying the ligatures. Peach-trees may

be budded most rapidly, and cherry-trees next; while, of the pear and plum, half the number named would often be a good day's work.

The following modes of propagation are adapted to different trees and fruit-bearing shrubs:—

Apple and *pear*, budding and grafting.

Cherry, mostly by budding, but succeeds well by grafting, if done very early.

Peach and *nectarine*, by budding only, at the North; often succeeds by grafting at the South.

Plum, by grafting, and also by budding, if the stocks are thrifty.

Apricot, mostly by budding; sometimes by grafting.

Almond, by budding, and sometimes by grafting.

Chestnut, by early grafting.

Walnut, by early grafting, and by annual budding.

Quince, by cuttings and grafting.

Filbert, by suckers and layers. The finer sorts may be grafted on the more common, which reduces the size of the bush and makes them more prolific.

Grape, by layers and cuttings; and, in rare instances, grafting is advantageously employed for new or rare sorts on old or wild stocks, producing rapid growth and early bearing.

Raspberry and *blackberry*, by suckers, cuttings of roots, and layers.

Gooseberry and *currant*, by cuttings, and sometimes by layers.

Stocks for Fruit-Trees.

A few words on this subject may not be out of place in conclusion. For standard or orchard-trees, the pear and apple are grafted or budded upon seedlings raised from pips of any thrifty sort of each of these fruits. The Mazzard and Black Heart furnish good stocks for grafting with the cherry. At the West, where the cherry is easily injured, stocks raised from seeds of the Dukes and Morellos are the hardiest for all kinds of cherries. The horse-plum makes a good stock when it will grow freely for this purpose; but, in localities where it will not, the wild or Canada plum, of the largest growing varieties, is a good substitute. The peach and nectarine are usually worked on common peach-stocks; but they make very hardy trees on the hard-shelled almond; and, on the plum, the trees are hardy and of slower or more dwarfy growth. The apricot does well on the peach or plum, or on its own roots. Cultivators differ as to which is the best on all accounts.

For *dwarfs*, the Angers or French quince, is used wholly for the pear. The Doucin and Paradise are employed for dwarfing apples; the former being for the larger or medium-sized dwarfs, and the

latter for small ones, the apple-trees worked upon it not growing much larger than currant bushes. The Mahaleb is used for dwarf cherries, reducing their size and vigor of growth but slightly, however. It enables the cherry to grow better on heavy soils. All these stocks have mostly been imported from Europe; but nurserymen are beginning to raise them in the United States. The smaller varieties of the wild plum form, perhaps, the best stocks for the growth of dwarf plums.

REPORTS

OF THE

AMERICAN POMOLOGICAL SOCIETY.

Conformably to the call of Colonel Wilder, President of the American Pomological Society, its Sixth Session was held at Rochester, New York, in September, 1856, among the objects of which were the following: "To bring together the most distinguished pomologists of our land, and, by a free interchange of experience, to collect and diffuse such researches and discoveries as have been recently made in the science of pomology; to hear the Reports of the various State Committees and other District Associations; to revise and enlarge the Society's Catalogue of Fruits; to assist in determining the synonymes by which the same fruit is known in America or Europe; to ascertain the relative value of varieties in different parts of our country; what are suitable for particular localities; what new sorts give promise of being worthy of dissemination; and, especially, what are adapted to general cultivation."

REPORT FROM THE STATE OF MAINE.

BY S. L. GOODALE, OF SACO.

The season of 1855 was a favorable one for fruits generally; and at the exhibitions of the local societies, fruits in variety were shown in as great abundance and perfection as is usually the case in the other New England States.

The winter of 1855–'56, so disastrous in many sections of the country to horticulturists, though steadily cold, was at no time severely so, the lowest point at which the mercury stood, being 17° F.

From about Christmas, for three months, there was little change; not even a January thaw. Snow fell in great abundance, and passed away in spring easily, quickly, and doing no harm. Fruit thus wintered in safety. The only harm being by mice; nor was this extensive, and strong hopes were entertained of another fruitful season, which have not been fulfilled.

Apples and Pears.

About the time of blossoming of the apple and pear, cold winds prevailed, and from this, or some other cause, the bloom did not set so well as usual, and the little which did grow, was most imperfect and stung by insects. Pears have cracked more extensively than has ever been noticed before. Consequently, there are few varieties which can be said to be more fully proved than heretofore. Of these, we may mention Belle de Noël and Beurré Clairgeon as growing fair, ripening well, and proving of fine quality, besides others which have hitherto succeeded quite as well as these, but failed to do so the present season.

Grapes.

Of the newer grapes which have been proved, the "Concord" is found to ripen with the Diana, about ten or twelve days before the "Isabella," and is of good quality, but by no means equal to the Diana in flavor. The Hartford Prolific ripens a week or more earlier still, and proves fully equal to the Concord in size and quality; a rapid grower, good bearer, hardy and valuable for our short seasons, and would probably prove a valuable market grape for the South.

REPORT OF THE MASSACHUSETTS POMOLOGICAL COMMITTEE.

BY EBEN WIGHT, OF DEDHAM.

On the 5th of September, the Committee of the American Pomological Society, desirous of reporting upon some of the numerous varieties of pears cultivated in the extensive garden of Col. Marshall P. Wilder, of Dorchester, made him a visit, and, as usual, were very cordially received.

The comments which follow are the opinions gathered from the remarks of Col. Wilder, upon the varieties fruited upon his grounds:—

PEARS.

Beurré de Wael—large, promises well, resembling in fruit and tree the Napoleon; ripe in October.

Beurré Sterckmans—known in France as Beurré Hardy, sustains its reputation.

Lodge—maintains its high character, bearing abundantly.

Beurré Clairgeon—promises to be one of the best of our late acquisitions, and from its beauty and size is becoming a general favorite.

Beurré d'Anjou—still considered one of the very best autumn pears, always large, fair and delicious. Col. Wilder remarked that, if he had introduced the Beurré d'Anjou only, he should feel that he was a benefactor to the pomological world, and nearly repaid for the twenty-five years of labor he had spent in the cause.

Retour de Rome—a handsome yellow pear of fine flavor, promises to be very good. Is a strong grower, and bears abundantly; ripe in September.

Charles Van Hooghten—equal in size and beauty to the Onondaga, of similar quality; suited for orchard culture.

Comte de Flandre—a handsome variety, resembling in form the Marie Louise; long, promises well; ripe in October.

Sterling—promises to be a good market variety.

Gedern Paridant—a russet pear, great bearer; as an orchard variety quite equal to Beurré Capiaumont; ripe in October.

Abbott—improves on acquaintance, is always fair, very handsome and of good quality; season, October.

Beurré Superfin—equal to Brown Beurré in its best state; never known to crack; high, delicious flavor; ripe in October.

Doyenné Boussoch—a magnificent pyramid tree on the pear stock, where it succeeds better than on the quince; when picked early, will prove a great acquisition as a market pear.

Comtesse d'Alost—a new sort, equal in beauty and quality to Louise Bonne de Jersey, which it resembles, but is later.

Pratt—maintains its high character as a delicious fruit; ripe in October.

Beurré Kermes—a russet pear of excellent quality; ripens about the last of September; is wonderfully productive. Size, medium; rich flavor.

Rousselet de Meester—synonymous with Comte de Lamy, Beurré Curtet, Dingler, &c.

Beurré Scheidweiler—a late autumn fruit, new with Col. Wilder, but is considered by Mr. Berckmans, who knows the variety, as excellent; its appearance is promising.

Nouveau Poiteau—magnificent tree, unsurpassed for vigor, hardiness and growth; fruit very large, and the crops enormous; does not rot at the core, but the flesh is rather too buttery; desirable for the orchard.

Conseilleur Ranwez—a large, handsome pear, desirable for orchard culture; very hardy and productive; quality, medium.

Fondante de Malines—maintains its character in full. One of the best late autumn sorts.

Kirtland's Seckel—excellent; quality, nearly equal to Doyenné Gris.

Beurré Langelier.—This variety has flowered with Col. Wilder for six years abundantly, but does not fruit until the trees are mature; an old tree does well. An excellent winter variety.

Emile d'Heyst—a large, excellent fruit, with rich, piquant flavor; ripe in October; promises to be a great acquisition.

Calebasse de la Vigne—a very large, handsome and excellent fruit; ripe in October.

Pie IX.—handsome, large as Glout Morceau, and somewhat resembling the latter in color and skin; flesh, melting and juicy, with pleasant sub-acid flavor. The tree is very vigorous and hardy, and promises to be a valuable autumn fruit.

Lawrence—is a universal favorite. Col. Wilder considers it next to his fovorite d'Aremberg, and a much better grower. The fruit is always fine.

Shepherd's Seedling—a new pear, raised in Dorchester, near Col. Wilder's; is attracting much notice. The fruit is very large and handsome, ripening in October. The tree is hardy and produces abundantly.

Apples.

Washington—in all respects equalling, and immediately following, the Gravenstein.

Polish—of medium size, handsome, well-flavored; ripens through mid-winter.

Nectarines.

Stanwick—in flavor and appearance, surpasses all other varieties.

Strawberries.

Brighton Pine—a new variety, which possesses all the qualifications of a good strawberry for general culture.

Jenny Lind—fully sustains its previous reputation. Of the foreign varieties, which have succeeded well the past season, may be named Sir Harry, Admiral Dundas, Sir Charles Napier, and Omar Pacha.

Grapes—[out-door culture.]

Rebecca—originated by Mrs. Rebecca Peak, of Hudson, New York. A white grape; when fully ripened, is shaded with amber, and strongly marked with strawberry flavor. A valuable acquisition.

Delaware—a small berry, much resembling the Rose Chasselas. Commences coloring August 17th; fully ripe September 5th.

Union or Union Village—equal in size to the Black Hamburg; well-flavored; ripening ten or fifteen days previous to the Isabella.

The above three varieties were grown by Mr. Bracket, Winchester Massachusetts, an amateur in grape-culture, in the immediate vicinity of Boston. The Rebecca, which was tested by the committee, at the Annual Exhibition of the Massachusetts Horticultural Society, September 16th, 1856, was from Mr. William Brookbank, of Hudson, New York. The Delaware and Union were grown by Mr. Bracket, who has ripened all their varieties upon his grounds, which fully sustains the fact, that all can be relied on as ripening seasonably in this section.

REPORT FROM NEW YORK.

BY BENJAMIN HODGE, OF BUFFALO.

PEACHES.

Having turned my attention of late to the growing of the more choice varieties of fruits, and having a large farm at Peach Haven, mostly devoted to this purpose, I therefore shall confine my remarks, mostly, to fruits grown at that place. Peach Haven lies at the foot of Grand Island, in the Niagara River, about 5 miles above the Falls. The soil is mostly a black, sandy loam, with a clayey loam subsoil; easily worked and made mellow and friable. A good strong soil, producing fine crops, famous for the growing of the peach and the melon. The land lies rather flat, and only some four to eight feet above the level of the river, and hence rarely suffers from drought. The dense forests on the south and west completely shelter it from the blasting effects of the cold west winds. Grand Island is about 12 miles long and 6 broad. Buckhorn Island lies just below, and contains about 150 acres. Further toward the Canada shore, and a little below Buckhorn, is Navy Island, so noted in the "Patriot War." Very near the American shore, and opposite the foot of Grand Island, lies Cayuga Island, the residence of Mr. John Burdett, who has a large peach-orchard, kept in superior order, and the most extensive strawberry plantation in the vicinity of Buffalo.

Perhaps I may as well say, in passing, that, in the cultivation of fruit, my attention has been more particularly called to notice such varieties as can be grown successfully for market purposes; not forgetting, however, that none should be grown falling short of good flavor. A large proportion of the peaches sold in the Buffalo market, are not only of inferior flavor, but also of inferior size. "Public opinion needs correcting," says a fruit-dealer; "everybody calls for the 'Early Crawfords' and 'Honest Johns.'" Says I, "the 'Early Yorks' and the 'George the Fourths' are far superior." "No matter for that," says the grocer, "the large, high-colored peaches bring the highest price."

In my judgment, the peach cannot be successfully cultivated unless the ground is well prepared, and mostly kept free from weeds and grass. No grain-crop, whatever, should ever be grown among the trees. The cutting-back system is almost indispensable; and, when the trees are in full vigor and healthy, nearly the whole top of the tree may be cut off at once. In two years after, the tree will again have formed a fine, compact head. In a word, the life of the tree will be renewed, and will then hold on for several years.

The Early Ann Peach is an old variety, only valuable for its earliness. Fruit, of very small size, and perhaps may be called *good*. Tree, a fair grower, and often productive. But, with us, this has been superseded by

Fay's Early Ann.—This is a seedling from the old Early Ann, originated by Mr. Lincoln Fay, of Chatauque county. Fruit, of nearly medium size, round, of a creamy white, sometimes faintly tinged with red on the sunny side, and when fully ripe, beautiful in appearance. Flesh, white, juicy, rich and fine. The tree, hardy and productive, ripens nearly two weeks before Crawford's Early. Flesh, very tender, too tender to be transported to market; *very good.*

Noblesse.—This sort is well described by Thomas. Fruit, of superior flavor; *best.* The tree, a close, compact grower, of moderate size. Its unproductiveness, with me, is a bar to its cultivation; rarely yielding one-fourth of a crop; rather better, however, this year than usual, perhaps producing half a crop.

Serrate Early York.—This invaluable peach succeeds well, and has proved more hardy than almost any other of the more choice varieties. Indeed, we often obtain a crop from this, where many others fail. Fruit, of medium size; flesh, white, tender, juicy and rich. Has few superiors, and ranks as *best.* Ripens last week in August. Tree, a fine, close, compact grower, never attaining so large a size as many other sorts.

Early Tillotson.—I fancy the "books" have led fruit-growers far astray in regard to this fruit. It is here quite out of its latitude. I have never found a fruit-grower that was satisfied with it. Tree, a very slow grower, and requires a very rich soil. A very poor bearer, rarely producing one-fourth of a crop. One side of the peach often ripe, while the other is quite hard. Said to do better when the trees become old; but, after trying them for eight years, my patience has become quite exhausted, and the mandate has gone forth "cut them down."

George the Fourth.—The tree and fruit are well described by Downing, bating the "productiveness," which I have looked for but never found. The fruit is *par excellence* first-rate, rich and fine; *best.* The tree is a fair, upright grower, and much of the outer branches often die out. With me, it has rarely produced over one-fourth of a crop.

Crawford's Early.—This is regarded by all as the peach for Western New York—the great market peach. Tree, a strong, vigorous grower, very hardy, and, for productiveness, has few equals. Comes early into bearing, and is almost a constant bearer. Matures its fruit well, and, when kept in a high state of cultivation, rarely overbears so as to exhaust the tree. Fruit, of the largest size, often enormous. Its great size and high color make it a very saleable fruit. Many baskets of this peach, with single specimens measuring from 8 to 12 inches in circumference, were sold in our market this season, at $3 50 a basket, when other choice sorts, like George

the Fourth, were selling for half the money. No peach with us is so extensively grown as this; *good* to *very good.* Ripens early in September.

Crawford's Late—a valuable peach of the largest size, almost equal to the one last named. Ripens nearly three weeks latter than Crawford's Early. Fruit, of good flavor, rather tender, and does not very well withstand distant transportation to market. Should be gathered early. Tree, a fine, upright grower, somewhat tardy in coming into full bearing; but, on the whole, a fair bearer, and the fruit always commands the highest price in the market. Extensively grown in Western New York.

Grosse Mignonne—with synonymes "too numerous to mention." Fruit, "far-fetched and dear bought." Many spurious sorts are said to be sold under this name; and I have not only had these, but, as I suppose, the real article itself. Fruit, very fine, superior, has few equals, ranks as *best.* The "books" say it is productive. I have never found it so, but far otherwise. There is a mistake somewhere; either the tree is not productive, or, if it is productive, I have not the true sort.

Walter's Early—well described in the books. A strong, rampant, upright grower. The nurseryman who sold it to me, said it had no superior; but for six years it has never produced more than a fourth of a crop.

Royal George—a large, fine fruit, but, with me, it has proved quite unproductive; a shy bearer. Fruit, of a superior flavor; *best.* Tree, an indifferent grower.

Large Early York.—This variety is a good deal confounded with others. However, in Western New York, despite what the books say to the contrary, Honest Johns are not Early Yorks, and Early Yorks are not Honest Johns. The Large Early York, as described by Thomas, is a fine peach, of over medium size, white flesh, juicy, rich, and fine; *very good* to *best.* Ripens first of September. So far, however, it has not proved productive, or as much so as some other sorts.

Honest John—a well-known, yellow-fleshed peach, which probably originated in Western New York. Fruit, of full medium size, skin, yellow, with dark-red cheek, ranks in flavor not above *good,* and generally not as high. Ripens early in September. Tree, a most vigorous grower, and very productive, often yielding very large crops. Fruit requires thinning, otherwise the fruit will be small, and of inferior flavor.

Morris Red Rareripe—tree, a moderate grower, rather dwarfy in its habit. Can hardly be called a good bearer, yet sometimes, quite fair. Fruit, of medium size, and of good flavor.

Morris White—fruit, of medium size, and of a most beautiful creamy white, and, when fully ripe, seems almost transparent. Flesh, melting, juicy and fine. Ripens about the middle of September. May be called *good*, if not *very good*. A great favorite among the ladies, as, when gathered early, it has no superior for preserving purposes, and with all, very beautiful, which, with our good wives and daughters, has much influence. Tree, a close, compact grower, of rather small size.

Red-cheeked Melocoton—an old variety, well-known in the market. Succeeds well here, very hardy, and a most profuse bearer. Overbears, and, unless thinned out, the fruit will be small and inferior. Fruit, of medium size, and ranks no higher than *good*. Recommended as a hardy variety, constant bearer, and valuable where many other choice sorts fail.

Emperor of Russia—unique, cut-leaved, quite different from anything else in the peach line. Fruit necessarily grows pretty large, for a dozen specimens rarely grow on a tree; flavor very good. Very unproductive, and a bad grower. It is said to have originated in New York.

Red Rareripe.—We have a number of varieties of the peach under this name—some, no doubt, propagated from seedlings grown in Western New York, and others from something else. But the names among nurserymen and others have become so confounded and mixed up, that it has become a most difficult matter to define them. We have one or two sorts which are productive, and rank as high as *good*.

Oldmixon Freestone—a fruit of superior quality, of a large size, and most beautiful appearance. Its bright-red cheek, on a clear, yellowish-white ground, gives it a striking appearance. Flesh, white, and of a sweet, vinous, rich flavor. Ripens about the middle of September. I am not as yet fully satisfied with its productiveness. But, if on further trial its productiveness shall equal its other good qualities, I should write it down *best*.

I have found five sorts of first-rate market peaches, namely:—

Fay's Early Ann, Serrate Early York, Crawford's Early, Crawford's Late, Morris White, and also two others, nearly as fine, Large Early York, and Oldmixon Freestone.

Pears.

In former reports which I have read to the society, I have named many varieties of the pear, good, bad and indifferent. As a fruit-grower, and one that is planting out somewhat extensive orchards, I confine my remarks mostly to such sorts as I have heretofore supposed were worthy of extensive cultivation.

Bartlett—a famous old fruit; and, take it all in all, in my opinion, has no superiors. The tree comes early into bearing, and is very productive. Fruit, of large size and fine appearance. Flavor, very good. Ripens during the first half of September. The tree is a fair, upright grower; and, as it comes very early into bearing, I prefer it on the pear stock.

Rostiezer.—This pear seems to be but little known; at all events, fruit-growers and nurserymen have made but little noise about it. With me, it has proved uncommonly productive, both on pear and quince stocks, and an annual bearer. Fruit, of rather small size, growing in clusters, sweet, juicy, and of a rich, perfumed flavor, almost or quite equal to the Seckel in flavor; *best.* Ripens last of August. Tree throws out but few limbs, and those often grow to an immoderate length; requires cutting back. With a little care, the tree may be made to form a fine, compact head.

Tyson—another late summer pear, of fair size, productive, and of fine flavor, from *very good* to *best.* Tree, a fine, upright grower, and worthy of a place in every good collection.

Madeleine—a fine fruit when gathered early, but rots too soon at the core to make it valuable as a market fruit; *very good.* Ripens early in August. Tree, a fine, upright grower, limbs slender, and requires cutting back.

Doyenné d'Été.—This, with me, has not proved so fine as I had anticipated. It is too small for profit, soon decays, and flavor not above good. Ripens early in August. I have fruited it both on pear and quince stocks.

Dearborn's Seedling—a fine little pear, valuable for its earliness, but not a profitable sort, or not near so much so as the three first named.

Flemish Beauty—an old, well-known variety, which has few superiors. Fruit, of large size, ranks as high as *very good.* Tree, a good, strong grower, and very productive, succeeds well on almost any soil. Ripens late in September. Should be gathered early and house-ripened. Otherwise, it soon rots at the core.

Louise Bonne de Jersey.—I have found no pear which succeeds so well on the quince as this fruit, always large and fine, say handsome, and of good flavor; often *very good.* Tree, a fine, upright grower, producing large crops annually; ripens in October.

Onondaga or Swan's Orange.—I have fruited this on the quince stock only, and that with rather indifferent success. The tree makes a fine pyramid, and produces fair crops. Fruit, large, and fine in appearance, but generally coarse, and ranks no higher than *good.*

Paradise d'Automne—a fine fruit, of superior merit, full medium size, juicy, rich and truly fine. Has few equals, and ranks as *best.* Tree, a fine grower, and yields fair crops; ripens in October.

Grey Doyenné.—I have, as yet, only fruited this on the quince. So far, I am well pleased with it. Fruit, of over medium size, fine in appearance, and of very good flavor. Tree, a fine grower and productive; ripens in October.

Stevens' Genessee—originated in Western New York, where it has always been a favorite. Fruit, of large size, fine appearance, very juicy, and of good flavor; ripens last of September. Tree, a good grower, and very productive. Some have thought this variety to be more subject to the fire-blight than most others; I have not found it so.

Manning's Elizabeth.—Fruit, of small size, growing in clusters, of fine appearance and good flavor, sometimes very good; ripens last of August. Very productive, and an annual bearer. I have fruited it on the quince only. It makes a fine pyramid.

Seckel—the standard of excellence, has no superior; a beautiful fruit of small size. Always commands the highest price in the market. Tree, a slow, but compact grower, and productive; ripe in September and October.

White Doyenné.—Alas! and what shall we say about this our old favorite? Verily, its glory has departed. It is no longer fair and fine, as formerly, but spotted, gnarly, bitter and unsightly. Must we write it an outcast, or shall we rather dig about it and try to renovate it? On the rich, virgin soil of Grand Island, we yet hope and expect to see it fair and fine as formerly.

Beurré Diel—fruit, of the largest size, and of very fine appearance. Flesh, sometimes rather coarse, but generally juicy, rich and fine; succeeds well either on quince or pear stocks; a strong grower; ripens late in October or November.

Buffum—a fine, upright grower, and very productive. Fruit, of medium size, and of good flavor. I have found the fruit much larger and finer when grown in a rich, clayey loam soil. When grown on a dry, gravelly, sandy soil, the fruit sometimes cracks and becomes worthless. I at first fruited it on such a soil, and thought it worthless. I now regard it as a valuable sort; ripens late in September.

Winter Nelis—a very fine, late autumn, or early winter pear. Tree, a crooked, straggling grower, but, with judicious training, a fine head may be formed. Fruit, of hardly medium size, of fine, delicious flavor, inferior to no other pear of its season. A very fair, but not a profuse bearer.

Glout Morceau—varies very much in size, from small to large. Produces the largest and finest fruit when worked on the quince. Juicy, rich, sweet and excellent; always fine; ripens in November. Rarely keeps as late as Christmas. Tree, a strong, upright grower, and productive.

Beurré d'Aremberg—a fine productive sort. Fruit, of full medium, or rather large size, of a fine, rich, vinous flavor. Will keep until mid-winter.

Lawrence.—So far, this has proved very fine. Tree, a rather tardy grower, but very productive. Fruit, of medium size, and of very good flavor. The same tree has produced fruit three years in succession, and we may say it promises well.

Beurré Easter—an old, well-known variety. Keeps till spring. "The best late winter pear." Fruit, of rather large size; flavor, *good* to *very good.* A hardy, vigorous grower, and productive. Very valuable for its good keeping qualities.

In the foregoing, I have confined my remarks mostly to such varieties only as I am growing somewhat extensively at Peach Haven, and which I have fruited sufficiently long to speak advisably on the subject. In addition to the above, I have growing in my orchards, many of the newer varieties, such as the Beurré d'Anjou, Oswego Beurré, Beurré Langelier, Urbaniste, Duchesse d'Orléans, Vicar of Winkfield, &c., some of which now promise well. Others promise the reverse. One, two, or even three years, I have found by experience, is too short a time, to fully determine the qualities or merits of many varieties of the pear. No other fruit is so capricious.

Strawberries.

Of the strawberry, I must briefly comment. This fruit is most successfully grown in the vicinity of Buffalo. Mr. Burdett, of Cayuga Island, is, perhaps, the most extensive cultivator. Soil, a sandy loam, lying but a few feet above the level of the river. The soil is not rich, and produces but a meagre crop of corn, without manure. His largest and finest crops of the strawberry are grown on land without any manure, and where no manure has ever been applied. This seems to be contrary to the "books," nevertheless it is a fact, and my own personal observations on my own ground, and also on the grounds of others, have fully convinced me that the books are in error on this point. Manure highly, and you get rank, rampant vines, and but little fruit. Much, very much depends on the adaptation of the soil.

Hovey's Seedling—is extensively cultivated, and Mr. Burdett grows but little else; and in his plantation of several acres, he assures me, there is not one plant of any other sort, to a thousand of the Hovey.

In passing over the grounds, we see but here and there any other variety; and yet, in my judgment, there are enough to impregnate the crop. At all events, Mr. B. rarely fails of getting a bountiful crop. Fruit from the Hovey, large and fine, and, if not of the highest flavor, yet, by some means, always commands the highest price.

Large Early Scarlet—is also largely cultivated for market purposes. Generally productive, and, when grown in a good soil and with runners clipped off, so as to give ample space, and kept free from grass and weeds, the fruit is generally of good size.

Iowa—in my opinion, is the next best for a full crop. A strong grower, sending out a great number of runners, and, unless ample space is given, or the runners kept down, the beds will soon become matted and unproductive.

Burr's New Pine, Boston Pine, Hudson, Crimson Cone—and others, together with the Cincinnati varieties, are all grown here with various success. In closing this subject, I would merely say, that it has been found, by experience, better and more profitable, not to gather more than two crops from the same planting. It has been found less labor to prepare the ground anew, and plant out new vines, than to keep out the grass and weeds from an old plot. Nothing but young vigorous plants should be used.

REPORT FROM NEW JERSEY.

BY W. REID, OF ELIZABETHTOWN, AND L. E. BERCKMANS, OF PLAINFIELD.

Strawberries.

Nothing particularly new has been brought into notice since the last report. The present year has been favorable here for ripening this fruit, and generally a fair crop has been produced where ordinary care has been given to the cultivation. The usual way of cultivating for market, is in beds 2 or 3 feet wide. This method is attended with a great deal of trouble in keeping the grounds clean, and, from the crowded state the vines are in, greatly diminishes the size of the fruit. If the following plan were adopted, that is, planting in rows, 3 feet apart, and 15 inches in the rows, not allowing any runners to grow, which can be easily done by cutting them off once or twice in the course of the season, they can be kept as clean as any other crop, by hoeing, or by using the ordinary cultivator, where growing extensively for market, and labor-saving is an object. This way of cultivating has two decided advantages. In the first place, the cutting off all the runners, as they make their appearance, increases

and strengthens the crowns of the plants for the next year's bearing, which will cause them to form large trusses of flowers, and the fruit will be nearly twice the size of those cultivated in the ordinary way. The expense of gathering will also be much reduced, as a person will gather double the quantity, when grown in this way, than he would when grown in thick beds; at the same time, they will command an extra price in the market.

The ground for strawberries ought to be well prepared before planting, by trenching or subsoiling 15 to 18 inches deep, and mixing plenty of stable or yard manure with the soil when performing the operation. A plantation in this way treated, will last good three or four years without renewing.

The list of strawberries having been greatly increased lately by numerous seedlings, each raiser claiming some superiority to his favorite variety, makes it difficult to select the best, and, no doubt, there are certain kinds which suit different soils better than others. The following sorts have produced good crops here, namely: Early Iowa Scarlet and Large Early; and, in succession, Hovey's Seedling, Longworth's Prolific, Extra Red, Wilson's Seedling, Scotch Pine, &c.

Raspberries.

From the ready sale of the raspberry, in all the principal markets, a good deal of attention has been given to its cultivation. Like the strawberry, it requires good, rich ground, with a dry bottom, to produce strong canes. The "Antwerp" and its varieties being generally cultivated, and all of them being rather tender, they require to be covered, in the winter, by bending the canes and covering them with earth. The crop has not generally been so good this year as it was the previous season, the canes, in some instances, having suffered from the severity of the winter where they were not securely covered.

It is to be hoped, before long, that we will be able to produce varieties from seed which will be hardy, and equal in size and quality to those we now cultivate, it being easy to raise from seed. If as much attention were given to them as there is to the strawberry, no doubt good results would follow.

The varieties in general cultivation are, Fastolff, Old Red Antwerp, Franconia, and the North River Antwerp. Brincklé's Orange has produced well, and is by far the best of the white varieties. The common red and purple-fruited are still cultivated to a considerable extent for market, on account of their hardiness.

CURRANTS.

Currants well repay a little extra care in the increased size of the fruit. They require a rich, deep, well-manured soil, and by pruning out the shoots where they are thick, and moderately shortening the tops of those left, the size of the fruit very much increases. There is nothing yet that is much better for general cultivation than the Red and White Dutch Currant. The White and Red Grape are also good.

The *Cherry Currant*—is a very distinct kind, with large foliage and extra-sized berries, and promises to be valuable for general cultivation. The different kinds of Black Currants, which have been imported lately, have not been distinct, and seem to have no superior claim to merit over the old variety.

GOOSEBERRIES,

For the last two years, have been attacked by mildew, and have not done so well as usual. In lighter soils, they have been exempt, and fine crops have been produced. Gooseberries, like currants, require a rich soil and dry bottom. Salt hay, if put over the ground 6 inches deep, before the bushes begin to push in the spring, will, in a great measure, prevent mildew; covering well under the branches and adding a little sulphur to the bushes when they are beginning to come into leaf, mildew will seldom make much progress. To ripen gooseberries, they require to be shaded with a piece of cloth or mat from the heat of the mid-day sun; otherwise, they are liable to be injured. They are more valuable for tarts in a green state than they are for the table.

BLACKBERRIES.

The "Lawton" or "New Rochelle" Blackberry, has only been introduced two or three years in this neighborhood, but, from appearances, will, no doubt, be planted extensively for the market. It has fruited here, and fully sustains the reputation it has received from other cultivators. The berries are large, very productive, and, when thoroughly ripened, very rich and melting; and, from its long continuance in bearing, we think it will be quite an acquisition as well as profitable to cultivators.

Cherries.

Some new varieties have been introduced, and are now beginning to bear, namely: Belle d'Orléans, Augustine de Vigney, and Belle Agathe. The former promises to be a valuable early cherry, soft-fleshed, and has some resemblance to Belle de Choisy, but belongs to the class of Heart cherries.

The following varieties have been noted as being the best: Belle de Choisy, ripening here about the time of the May Duke, and belonging to the May Duke family, although it would not be advisable to plant this variety for market purposes to any great extent, being soft-fleshed and not so suitable for carrying, and some seasons only an ordinary bearer; but, for a family cherry, there is certainly nothing superior grown here. Coe's Transparent is another that we consider a superior cherry, also May Duke, the old original variety; Holman's, and Late May Duke, and other varieties, are all inferior kinds to the old sort, and scarcely worthy of cultivation when the original variety can be had. There is no cherry equal to the latter for pies and tarts, and, when ripened, is a good table fruit. Kentish or Early Richmond, ripe about the same time as the May Duke, is also a valuable sour cherry for market.

The following varieties, in ordinary seasons, generally produce good crops, and are among the best for growing for market purposes and general cultivation: Knight's Early Black, Black Tartarian, Napoleon Bigarreau, Old Black Heart, Downer's Late Red, Black Eagle, Bigarreau, and Black Bigarreau, of Savoy.

For cooking purposes, Early Kentish, Common Pie, English Morello, Carnation, and Reine Hortense. The latter variety is very prolific, belonging to the May Duke class, large and one of the handsomest cherries in cultivation. This cherry ought to be cultivated extensively for the market. It has not, however, proved to be a fine desert fruit, as recommended by some cultivators, being rather acid ; but very valuable for culinary purposes.

The early varieties of white cherries have been, this season, here, almost an entire failure; a very uncertain crop in the best of seasons, and not worth planting, while we have so many others ripening at the same time.

The question is often asked, Is the cherry a profitable fruit to cultivate for the market? This depends altogether on the varieties selected, and the value of the ground. If land is cheap, and a proper selection made for the purpose—not as is usually made—that is, planting one hundred trees, and very often nearly as many varieties—in this way, there is nothing to be made by cherries. But let those planting for profit select ten or a dozen of the best kinds that grow strong and are hardy trees, and plant, say, five hundred or a thousand trees, and twenty-five or fifty of each variety, there is no doubt a very handsome income would be derived.

Pears.

The great increase of native varieties of this fruit, as well as foreign, within these few years past, has been the means of creating a desire to do away with many of the old varieties, and substitute those which are superior in quality and better adapted to our climate. In this good work, we are progressing, for which the community are greatly indebted to a few amateur cultivators, as well as to different societies; and we may well congratulate ourselves on the progress we are making, when we look back to what our exhibitions were twenty years ago, and compare them with the present time. Such tables and such a variety of fine pears as we see exhibited from year to year, we may safely say are not to be seen in any other part of the world.

Since our last meeting, in 1854, although we have not had a great many new kinds in bearing, we have had an oportunity of fruiting and testing again those varieties already noticed in our last report, to which are added a few brief remarks on the quality, &c., as we have found them for the two past years.

Early Pears.

Petit Muscat and Amiré Joannet—are the first two pears of the season, and being both small, are hardly worthy of cultivation, and are only suitable for an amateur collection; not for market.

Madeleine—being the next to succeed the above, and the first good early pear at this season, ripens from the 15th to the 20th of July; is a valuable orchard tree, producing large crops, and sells very readily in the markets. This variety is better on pear stocks than on the quince.

Early Catharine—(Rousselet Hâtif, of the French,) is another productive pear, coming in a few days after the Madeleine. Large quantities of this are grown in this State, and sent both to the New York and Philadelphia markets. Like most of the Rousselets, it is best to eat when gathered from the tree.

Beurré Giffard—ripening here about the end of July, the two past years, has borne fair crops; this has been of excellent quality, and quite melting. This tree on the pear root grows tolerably well. A tree planted ten years ago is as large as the average size of fifty other varieties planted at the same time. On the quince, it does not seem to grow so well, but on this stock produces fine specimens. The only objection to this fine pear is, it does not keep any length of time; perhaps this may not be generally the case.

Bloodgood—has produced, for the last two years, on the pear stock, tolerable crops, ripening here from the 1st to the 10th of August; a good melting pear, not very prepossessing in appearance, but well worthy of cultivation in amateur collections. These remarks apply to it on the pear root. Trees planted in 1843 are about 12 to 15 feet high, bushy, hardy and round-headed. I have not seen it bearing on the quince.

Dearborn's Seedling—the two past seasons, has been of the very best quality, very melting, and of a larger size than usual. This pear is very liable to overbear; when this is allowed, the fruit is often worthless, but, if ordinary crops are left to ripen, they have always been of the first quality. This tree, if left without pruning, makes long branches, which ought to be shortened back; if this is done, the fruit will be double the size that they are when left with large crops of fruit, and the branches left their full length; this applies to trees on the pear root. This pear has other advantages over many other fruits for market; it will keep for a considerable length of time after gathering, and also ripens gradually, from the 10th of August, and continues in season into September. The only fault which has been found with this tree here is, *in wet seasons*, it is liable to lose its foliage early; when this happens the fruit is not so good.

Rostiezer—proves to be a very productive variety, growing well on either pear or quince stocks, although not a handsome growing tree, being of a loose, straggling habit, yet of considerable vigor. This pear has a high reputation from several fruit-growers here. It has not been in bearing in our grounds any length of time, but, from specimens seen, promises well for a market fruit.

Beurré Goubault, Tyson, and Limon—have all borne good crops, and may be planted with safety. The two former do well on quince stocks; the later best on pear root. The Limon pear is deserving of particular notice. It was secured from the late Robert Manning, under the name of "Beurré Haggerston" a number of years ago, which proves to be the same as the Limon. It ripens here about the middle of August. We have no better pear in cultivation at this season than this, and very few better at any season of the year; it bears abundantly, and is well worthy of cultivation. The Beurré Benoist, Dazalonia, and Chenille, (supposed the same as Passans du Portugal,) early varieties, have been very good the past season, and promise well.

Fall Pears.

Bartlett—being so well known, it is almost superfluous to say anything about its many good properties. Without doubt, it is the most valuable market pear that we have for orchard culture, ripening at

that season. Trees of this variety seldom fail to bear a fair crop of fruit; this, as well as many other kinds, are frequently injured by allowing them to bear too much without thinning; the consequence is, the fruit is not more than half its usual size. It would be well for those growing for market to remember, that one bushel of good-sized fruit will command as high price as two of inferior size; also a much readier sale. This variety is cultivated generally on pear stocks, but recently there has been a great demand for them on the quince stocks; some of the largest and finest specimens of fruit have been grown in this way, although this variety is sometimes short-lived on the quince; yet, when the stock is well covered at planting, they will frequently make fine trees. This is caused, no doubt, by the tree making roots, when covered below the ground at planting, which makes it after a time independent of the quince roots. If this could always be relied upon, they would be perfectly safe to work on the quince.

Belle Lucrative.—This variety is very popular here, and produces fine crops, both on quince and pear stocks. The finest specimens, however, have been grown on the quince. This makes a good market pear; ripe from the middle of September to the middle of October.

Andrews—has produced fine crops the last two years, both on quince and pear stocks. This pear does not keep very long after gathering, unless retarded by keeping in a low temperature, but is of the best quality and very handsome.

Flemish Beauty.—This large and showy pear produces fine crops, both on quince and pear stocks, although rather slow to get up on the quince, for two or three years, yet makes a very good growth afterward, and produces fine specimens. This pear sells well in the market, its worst fault being its liability to rot at the core.

St. Ghislain.—This fine pear has again, the two past seasons, produced fine crops; ripe here in September. Very melting, and high flavored; grows best on pear stocks.

Duchesse d'Angoulême, *Louise Bonne de Jersey*, *Heathcot*, *Seckel*, *Cushing*, *Beurré d'Anjou*, *Beurré Bosc*, *Urbaniste*, *Onondaga*, and *Beurré Clairgeon*—are all varieties well worthy of general cultivation, and bear well, filling up the season from the 1st of October, to the 1st of December. For a more full account of most of these, see the last published Reports for 1854. Also the following have been in bearing and promise well:—

Beurré Kirtland.—This superior pear, which has some resemblance to the Grey Doyenné, but free from cracking, which the latter variety is subject to more or less, is well worthy of trial everywhere; a tree of vigorous growth, growing freely either on pear or quince stock, and quite melting; ripe in September. This is one

of the seedlings raised a few years ago by Professor Kirtland, of Cleveland, Ohio. Chancellor, Henry Fourth, Stevens' Genessee, Doyenné Boussoch, Ananas d'Été, and Beurré Superfin are all fine.

The following varieties are valuable as well as profitable for stewing: Windsor, English Jargonelle, Chelmsford, Hericart, and Hessel, being all very productive, vigorous growers, filling up the season from July to October.

Winter Pears.

Of this class, we are yet deficient in a good assortment to enable us to keep up a sufficient supply of table pears from the 1st of December to the 1st of May. The following kinds are among the best that we have in general cultivation at present:—

Beurré Diel—one of the finest of the early winter varieties, in season about the 1st of December. For the two last seasons, this pear has been of the finest quality, very melting and juicy, and, as the trees increase in age, the fruit seems to improve, requiring from eight to ten years on the pear stock, before they are in a fine bearing state. On the quince, they bear much earlier, and succeed well, holding their foliage better, which they are liable, sometimes, in wet seasons, to lose on pear stocks, before the fruit gets matured.

Winter Nelis—comes in after the former, and fills up the season to the 1st of January. This pear is one of the best at this season, melting, and very high-flavored. This variety grows rather slow when young, but increases in vigor with age, making a fine, healthy tree, and bears profusely. It also grows on the quince, but not with the same vigor as on the pear.

Beurré d'Aremberg—ripe about the 1st of January; is also a very excellent pear. The tree, however, is a poor grower, particularly on heavy soils, and difficult to get up of a good size; this is a great objection.

Glout Morceau—one of the best of our winter pears, in season from the 1st of January to the beginning of February; a tree of great vigor and hardiness, well adapted to general cultivation, does well on pear roots; also grows very strong on the quince, which prevents it from bearing on this stock as early as some other kinds, but, with a few years' growth, will begin to bear. It will then produce fine specimens of large size.

Beurré Easter—makes a fine, vigorous tree on the pear stock, and produces large crops, ripening from January until April. Some seasons, this pear is of the best quality; there is, however, a consider-

able loss sometimes in ripening. The following varieties have also been in bearing the last two years, namely: Beurré Langelier, Bergamotte d'Esperen, and Doyenné d'Alençon. These have been very fine, keeping well. The latter variety has kept until May. These trees are all hardy and vigorous, growing well on either pear or quince stocks.

Lawrence—is very promising this season, both on pear and quince; the pear stock, however, we think, will prove the best for this variety.

Apples.

The crops for the last two years have not been very abundant in this State; in some localities, however, although not very abundant, the fruit is fair, and of a good size. The following early varieties have done well, namely: Early Harvest, Summer Rose, Red Astrachan, Hagloe, Maiden's Blush, and Sweet Bough. Early Harvest proves here one of the best for early cultivation, and commands always a high price in our markets.

Red Astrachan—one of the most beautiful early apples in cultivation, sells for a high price, but does not keep very long before getting mealy and dry.

Hagloe—is very productive, and large, and a very good cooking apple; ripens through the greater part of August; and sells well in the market.

Summer Rose—does not always bear very abundantly, but is of excellent quality, both for cooking and the table.

Maiden's Blush—is a very popular apple in the New York market, and sells for a high price. It is generally gathered about the middle of August, and kept in barrels until the end of the month, when it is beautifully colored.

Fall and Early Winter Apples.

The following varieties are in cultivation, namely: Alexander, Drap d'Or, (of Cox,) Fall Pippin, Gravenstein, Hubbardston Nonsuch, Fameuse, Pumpkin Sweet, (Lyman's,) and Porter.

Alexander.—This is one of the largest apples grown, does not bear very abundantly; ripe in September. An excellent cooking apple.

Drap d'Or.—This apple succeeds remarkably well in this neighborhood; the tree, very vigorous, the fruit, of large size, and color of a fine golden-yellow; in season, during September; good for table or cooking.

Fall Pippin.—There is nothing better in cultivation than this, where it grows well; it does not seem to bear so well as formerly, and drops frequently from the tree before maturity.

Gravenstein—a fine, vigorously-growing tree, and an excellent apple, well worthy of general cultivation.

Porter—bears well, an excellent cooking apple, grows fair and handsome, quite as much so as in the neighborhood of Boston.

The following varieties of sweet apples grow well, and are suitable for orchard cultivation, namely: Jersey Sweet, Lyman's Pumpkin Sweet, for fall; and Danvers, Talman and Hartford's Sweetings for winter.

The following late winter apples succeed well, and are suitable for general cultivation:—

Rhode Island Greening—bears very abundantly, and produces fine, fair fruit; one of the most valuable and profitable apples grown here.

Hubbardston Nonsuch.—This variety bears well, and seems to be as well adapted for this climate as for the neighborhood of Boston; it does not, however, keep quite so late.

Monmouth Pippin.—This apple grows well in this neighborhood; is fair and smooth, and keeps well through the winter; it is excellent for market.

Yellow Belle-fleur.—Where this variety succeeds, there are very few apples that surpass it; a great bearer, and on young, vigorous trees, the present season, in this neighborhood, it is equal in size to what it ever was in the best condition.

Roxbury Russet—one of the best for late keeping. The Newtown Pippin produces well-flavored, fair crops, but not so profitable for market as some of those enumerated above.

In planting orchards, formerly, the early varieties of apples were neglected, and late winter sorts generally planted, as being more conveniently attended to at the season they ripen; but, at the present time, from the great increase of our seaboard towns, the supply of early apples is not near adequate to the demand; they are worth more than the best winter varieties, and are not attended with half the expense. What could be purchased for from 25 to 37½ cents a basket, ten or fifteen years ago, sell now readily at 75 cents or $1, and are likely to command high prices for years to come.

Plums.

In 1855, we had the best plum-crop that we have had in this neighborhood, for the last ten years. The present season, very little fruit has set. It seems, unless some remedy can be found for destroying the curculio, we shall have to abandon their cultivation to a few trees near houses and out-buildings, where the ground is walked on frequently ; they are seldom so destructive there as in cultivated grounds distant from buildings. The only thing that can be applied at a moderate cost, is air-slacked lime and sulphur dusted on the trees when wet with dew, in the morning as soon as they are in leaf. If this is done frequently, a moderate crop may be secured.

Nectarines.

Nectarines can only be cultivated here with any success under glass. The curculio seems even more destructive to this fruit, than to the plum.

Apricots.

Apricots, trained as espaliers, on trellises and houses, produce tolerably fair crops, but seldom set their fruit well, when trained as standards.

Peaches.

Peaches, this season, are almost an entire failure, all through the State; the severity of the last winter injured the flower-buds as well as the tree, so that very few have set, and what have, is of inferior quality. The young trees are looking, in general, tolerably well, but all those which have arrived at a bearing state, have been so much injured, that it will require two years to get up again a good stock. The previous year, the crop was very abundant, but of inferior quality, and, in consequence of the two past seasons being unfavorable, nothing particularly new or valuable has been brought into notice.

Varieties in General Cultivation for Market.—Early York, Crawford's Early and Late, Oldmixon Freestone, Morris White, Late Heath Cling, Early Newington, or Large Early York, Cole's Early Red, Rodman's Cling

For Family Use.—Druid Hill, Grosse Mignonne, Noblesse, George the Fourth, Royal George, Bellegarde, and Coolidge's Favorite.

The soil best adapted for peach-trees is a sandy loam. No grass nor grain crop ought to be sown amongst them, and the ground kept cultivated with light root-crops, such as potatoes, &c. The best age to plant, is one year old from the bud, thrifty and well grown, and cut back to form low heads at the time of planting. The peach-worm, which attacks the roots, is the only insect that is to be guarded against. This is easily kept clear by examining the trees about the beginning of September, and cut them out with a small-pointed knife; they generally attack the trees at the surface of the ground, and where they have commenced, the gum will generally be found at the spot. The worm is generally small, at this season, but, if neglected until spring, will sometimes completely girdle the tree.

Quinces.

The quince is cultivated to a considerable extent through this State; it grows well and bears abundantly. The Apple or Orange variety is generally cultivated. The Portugal and Pear-shaped are also grown in limited quantities. The quince is a very profitable crop, and sells always readily in market. An acre of trees, planted 10 feet apart, would yield a very handsome income. This tree, however, seldom receives much attention, and is generally planted in neglected places. Many suppose that quinces ought to be planted in wet ground. This is not the case; they will grow and flourish better, if planted on good, loose, well-cultivated soil, with a dry bottom.

Grapes.

The *Isabella* and *Catawba*—are two of the best which we have in general cultivation, and sell well in our markets The Diana and Concord have not yet got fairly introduced, but are beginning to be cultivated in small quantities. For this climate, they are not likely to be of as much value as they will be for the North, where they are represented to ripen earlier. The Concord is a very vigorous, hardy grape; and, if not quite equal to the Isabella, is well worthy of cultivation.

REPORT FROM NEW JERSEY.

BY L. E. BERCKMANS, OF PLAINFIELD.

PEARS.

The severe winter of 1856, from January to April, together with the unusually high temperature of June, July, and a part of August, and also the protracted drought of the mid-summer, have proved a severe trial, not only for the pear, but for all other fruit-trees. Those pear-trees, which have withstood these trials, may be called hardy indeed. The quince-trees have suffered, and their extremities have been blighted soon after blossoming. Many varieties of the pear have been affected by a more severe blight, killing in some instances the whole tree; in others, from 5 to 8 or 10 feet of the top. Those which have suffered the most, have been the Glout Morceau, Vicar of Winkfield, and some weak, fancy varieties. It is a strange fact that some pear-trees, growing in the immediate vicinity of some affected quince-trees, have been all more or less injured, while, in other parts of my grounds, I have not seen a single blight, and chiefly, no blight of the extremities; showing that the same disease did work in the same manner, upon some pear-trees, as if by contagion.

Weak or diseased trees have been either altogether or partially killed; and, far from considering that as an evil, I deem it rather a benefit, as such trees cannot be removed too soon, and replaced by sound ones; there being little benefit to be expected from a tree, struck by some internal disease, which sooner or later must come out.

PEACHES.

Peach-trees, especially in a sickly condition, have been killed off by the score and the hundred. One of my orchards, containing vigorous peach-trees of different varieties, all about four years old, did not suffer in the least; while some stray peach-trees, not under so good cultivation, are in a condition to warrant their removal and replacing by sound ones.

CHERRIES.

Cherries have bloomed profusely, but the fruit has rotted badly; among these, the greatest sufferers have been the Dukes, (May and Late, &c.,) the Ambers, and the Spanish White or Yellow.

The severe winter, and the not less severe drought, have injured a great many newly-planted trees. If these show signs of disease down to the base, and all over body and limbs, I think it safest to take them up, and plant new, healthy trees in their places. They will suffer for a long time, and some will never recover.

Many seedlings of weak habits, and perhaps not fitted for the climate, have given up, of which I do not complain; such trials being the best and surest tests of hardiness and fitness for this country.

Apples.

The apple-trees have not materially suffered, but the blossoms have not set well; which, perhaps, is to be ascribed to the rainy and damp weather prevailing just at that time. Worms have never before destroyed so many crops. Three apples out of five are stung, and unfit for keeping.

Strawberries, Gooseberries, and Currants.

Strawberries, gooseberries, and currants have been in fine condition, and yielded immense crops, although the currant was much affected by the drought, or rather by the hot weather, the thermometer for three weeks, or twenty-five days, having been constantly between 85° and 100° F. in the shade. The currants, being a product of the northern latitude, we should not be surprised to see them suffer, even under best cultivation and in deep soils, by such a normal condition of the temperature. Among my best seedlings of the pear, on trial, those of Van Mons, seventh and eighth generations, have proved the most hardy, as they are the best in appearance.

Plums.

Plums, as usual, have nearly all been destroyed by the curculio. Until we shall find more convenient, more easy, general, and less costly means to prevent the destruction of the fruit by that inconquerable insect, I shall give up the plum-culture. An isolated orchard of plum-trees, watched, cleaned, and swept every day, after repeated shakings, during at least fourteen or twenty days, will, no doubt, yield fine crops, but it requires particular attention, and should be a special business.

REPORT FROM PENNSYLVANIA.

BY THOMAS P. JAMES, OF PHILADELPHIA.

The State Fruit Committee beg leave to submit a report on the culture of fruits, mostly in the eastern portion of the State, not so general as desirable, owing to the difficulty of obtaining one willing to furnish data from the western division.

An increasing interest in the cultivation of fruits, especially in and about Philadelphia, is manifest. Many gentlemen of means are directing their attention to, and are engaged in, the propagation of fruit-trees. The time is not distant, when our citizens will be abundantly supplied with these luxuries—the choicest of fruits. This interest is extending throughout the State.

From the county of Chester, an accurate observer and extensive cultivator, selected as a member of the committee, writes: "That it would be desirable to ascertain the causes of failure of certain good varieties of fruits, and to be able to state the differences of growth in distinct sections of the country." He resides in the southern portion of the county, and the soil is a clayey, and, in some places, a micaceous loam. Another gentleman of the committee, residing in the county where the soil is of a limestone formation, says: "In these two divisions, a great diversity is apparent in the growth of the same varieties of fruits," for instance, the Osband's Summer Pear, with him, is very poor; and, with the other, it is very fine, better than Bloodgood; the Beurré Capiaumont cracks all over, even into the centre, and is worthless. With the latter, it is large, smooth and fine. The Urbaniste, with him, is poor, coarse and gritty at the core; and, with the other, fine. The Flemish Beauty is excellent with him, and fails with the latter. It would be manifestly improper for the one or the other of these gentlemen to condemn popular varieties, until the cause of failure be known. In no better way could this desirable object be attained, than in the establishment of a National Pomological Garden, where experiments could be conducted properly and scientifically. In such a garden, too, fruits could be tested, qualities determined, names established, and scions, true to names, be disseminated.

In that portion of Chester county, in the neighborhood where this gentleman resides, the newer fruits have not been much grown as yet. The following comprise those in cultivation:—

Apples.

Bough, Queen, Early Redstreak, Rambo, Cart House, Grey House, Newtown Pippin, Grindstone, and Pennock. Of these, the Bough is good enough; so also, the Rambo and Cart House; but, for some

reason, of late, the trees are becoming short-lived, and the fruit knotty. Green Newtown Pippin is a fine, sprightly fruit, but the old trees are disappearing, and young ones are not supplying their places; something wrong—the soil possibly does not suit this kind. Such of the new sorts as are introduced, are not in bearing to any extent. Knowles' Early, Prince's Early Harvest, Summer Rose, Townsend, American Summer Pearmain, Jeffries, and Maiden's Blush are now the best tried summer apples. The Townsend, in particular, deserves to be elevated; it is a native of this State, a healthy, handsome grower, regular bearer, and with fruit of fine size, smooth and valuable for eating or baking, and makes excellent dried fruit; its season and size are favorable for such purposes. Few apples excel the Jeffries, (a native of the county,) for dessert, but I have it not in sufficient quantity for a full trial.

Of *Autumn Apples* are the Smoke House, Republican Pippin, Holland Pippin, Gravenstein, and Hayes, which are well tried. The Smoke House is the most valuable for all purposes; it is a sure bearer, smooth, good-sized, rich and substantial, good for cooking in autumn, continuing in use until spring; keeps well, and was eaten this year in May; it is good for eating, but its richness surfeits, and it cannot be eaten to the extent of the Rambo, and those more juicy kinds. Republican is equally good, but is not a good bearer. Holland Pippin is a good kitchen fruit, but does not remain long on the tree. The Hayes seems to be on the decline, like the Cart House; trees do not live long, and the fruit is frequently knotty.

The best *Winter Apples* grown in Chester county are the American Golden Russet, Yellow Belle-fleur, Smith's Cider, Fallenwalder, Rhode Island Greening, Long Island Russet, (of Massachusetts,) Baldwin, and Ailes. The American Golden Russet is superb. Yellow Belle-fleur is pretty good, but is so uncertain a crop, that it will have to be abandoned. Smith's Cider is productive to a fault, but its juice is not rich. Fallenwalder does well in fruiting, and hanging on, for a large fruit. Rhode Island Greening has done well, but of late, it is less productive. Baldwin promises well. Ailes is a seedling of that section; is a long keeper and rich; very firm and fine in texture. It, with many others, may be superseded by the Northern Spy, King, and others, and so little may be said of it abroad.

It may be well here to remark, that many farmers, in planting orchards, desire one-fourth of their trees to be of the Smoke House. The writer, if planting for market purposes, would set out seven-eighths, if not all of that kind. Apart from its productiveness, it will command one-fourth to one-third more in the market than other kinds.

Pears.

In this part of the country, one hundred and fifty varieties were tested, many of which were very poor. Of the new varieties from abroad, ten worthless ones are received to one really good. A list

of those entirely worthy, is short, namely: Bloodgood, Rostiezer, Tyson, Ott, Washington, Bartlett, Belle Lucrative, St. Ghislain, Seckel, and Lawrence; several others approach the above, but have some defects, as, Dearborn's Seedling, Osband's Summer, Madeleine, Beurré Giffard, Beurré St. Nicholas, Beurré Haggerston, Camerling, De Bavay, Marie Louise, Buffum, Duchesse d'Angoulême, Flemish Beauty, Dunmore, and Stevens' Genessee; Beurré Giffard did finely for two years, and was looked upon as a great acquisition among the early pears; but, last year and the present, it has cracked badly, and cannot be recommended. Beurré Clairgeon has turned out much the same. It would not be proper to condemn these, but record such observations for the benefit of others. Beurré Oudinot is promising very well. Judgment on the others it would be well to suspend until further trial.

No pear-blight has made its appearance as yet, this year, which, in former years, frequently has occurred. The trees live and grow on the quince stock, but are less early fruitful than was anticipated; for substantial, durable trees, the pear stock is preferable.

Cherries.

The writer has over one hundred varieties on trial; but this year the crop was a failure. The best are the May Duke, Bauman's May, Early Richmond, Yellow Spanish, Carnation, Elton, Downton, Black Eagle, and Napoleon. The best cherries tasted by the writer were, Belle d'Orléans, Coe's Transparent, Reine Hortense, Governor Wood, and Belle de Choisy.

Quinces.

The Orange and Portugal do well; the latter is not so large, but in quality superior.

Raspberries.

Of fifteen varieties fruited, Orange rates first in value, and next to Franconia. French is said to be proving very satisfactory, but it has not fruited here yet. It may be remarked that, in this section, (Chester county,) we have perpetual-bearing raspberries, (native,) equal, if not superior, to Longworth's Ohio; they yield fruit throughout the summer. Seedlings from them are raised in gardens, and the fruit somewhat improved, but still they are the black-cap class, and not very good—hardiness and productiveness, for a long time, are their chief merit. In a little town, in passing through the coal

regions and mountains, this summer, the writer found a wild raspberry, with which he was much pleased; in its appearance much like an Antwerp, but of higher flavor than those in cultivation; observed and tasted from Pittstown to Bear Creek and White Haven.

Currants.

Of twenty varieties, White and Red Grape, White and Red Dutch still prove the most valuable for all purposes. Cherry is fine in size, and Knight's Sweet Red the most palatable.

Gooseberries.

No gooseberries do in this section but the Cluster; it is valuable, very productive, and free from mildew. Houghton's Seedling does not escape mildew.

Grapes.

Catawba is decidedly the most valuable kind yet tested. The Diana is smaller fruited, bunches less, and no earlier than the Catawba, nor better in quality; of the two grapes, the Catawba was more ripe, and nearly twice as large, the first week in September. About the middle of August, a variety was ripe, (Canby's August,) which may prove an acquisition for earliness; it is not yet sufficiently tested, but appears considerably like Isabella in color and taste. Clinton does well, is productive, and valued for culinary purposes. Ohio seems too tender and gets winter-killed.

Strawberries

Have been too much neglected. For quality, Burr's New Pine is the best. The most productive are Longworth's Prolific, Schmitz's Pistillate, McAvoy's No. 1, and Crimson Cone, but all a little too acid. Hooker promises well.

From a letter by William G. Waring, of Centre county, I extract as follows: "I have principally to remark, that we have had the same experience of the destructive effect of last winter's severity as is reported from all quarters, and that destructive insects are steadily increasing and advancing. The borer, the cherry and pear slug, and a species of caterpillar which is very destructive to the foliage of plum-trees, have just reached us.

"Some Mazzard cherry and plum-trees, and old peach-trees have been killed outright from the roots. Pear and peach-trees throw up strong branches from the roots, so do grape-vines. Where the Isabella and Catawba were sheltered by walls, they produced well, but opened out later than usual. The only bearing plum-tree which I know of, stands sheltered on three sides by walls, otherwise in a cold place. Grafts from the same tree grew well, while others mostly failed.

"We have no peaches, but had a fair crop of cherries, and have many pears and apples.

"The thermometer was as low as 23° F., and was below zero constantly for three days at one time, and four at another, and frequently for shorter periods. We had a deep snow through the winter, or the cold would have been much more destructive.

"I think one lesson of importance may be derived from late experience, which relates to the favorite fruit of our climate, the peach. Any means which can be devised to secure greater regularity and certainty of crops of this universally-admired fruit, must be welcomed by everybody; especially since the process of preserving it in cans has extended its season, and, consequently, availability so greatly, making it now second to no other fruit in value, unless some would still except the apple.

"The wood of the peach suffered injury last winter to an extent which has induced everybody to apply the knife; and this application disclosed a condition of things under the bark, that alarmed all who had never observed it before.

"But in our ordinary winters the wood is discolored, the sap-vessels ruptured, and the first leaves, formed from the winter stock of sap, come forth distorted and blistered. As soon as the spring flow of sap finds channels through which it can course upward, new leaves are formed, which are healthy, and a layer of new, healthy wood, begins to be deposited under the bark, but beneath it is rottenness and decay. The first leaves fall, and the tree soon begins to wear outward a healthy, thriving appearance.

"That the 'curled leaf' and the decayed heartwood are produced by the severity of our winters acting on a half-acclimatized tree, is evident on examination of the wood at the surface or below the snow line. The knife displays white, clear and healthy wood; and the leaves and shoots that issue from this portion are healthy, too, and unaffected by the curl.

"Now, what I should like to have discussed and determined, if possible, is, whether we can have peaches of the best quality *on their own roots*, either by seeds which can be relied upon to produce their like, which I much doubt, in regard to any, especially in a mixed orchard—or by layering, which seems sure, and which I hope may be feasible. We could then apply the removal system to the peach, cutting to the ground. The branchlets would lie over like untrained raspberry canes, and might even be covered with pine branches or the like, or would receive protection from snows. The permanence of the trees or stocks would be greatly increased, and the size and

flavor, and facility of gathering the fruit would be in proportion to the abundant supply of sap, and the health of the foliage, and these depend on the proximity to the sap-supplying roots, and the soundness of the channels which convey the sap.

"Among the hardiest of the cultivated varieties, as I have found them, are the Crawford's Early, Yellow Rareripe, or Alberge, and a later yellow peach, superior to either, for which I have no name.

"Of white peaches, Large Early York, Snow, and Hill's Madeira, (of Kenrick, not of Elliot,) have been the most uniformly and abundantly fruitful; but of these the Snow Peach is the only freestone, and, though handsome, is deficient in flavor, as compared with the others.

"A very extensive and complete plantation of all the fruit of our climate is in the course of establishment on the large Experimental Farm of the Farmers' High School of Pennsylvania, and will soon become a source of accurate and extensive knowledge of the habits and values, in this limestone region, of all varieties now in cultivation."

PENNSYLVANIA SEEDLINGS.

FROM THE MEMORANDUM KEPT BY W. D. BRINCKLÉ, M. D.

APPLES.

Philippi—grown by William Fisher, of Berne township, Berks county. Size, large, two and a half inches by three and five-eighths; form, oblate-conical; skin, greenish-yellow, with numerous blotches and grey dots, and a blush on the exposed side; stem, short and slender, three-eighths by one-tenth inches, inserted in a wide, moderately deep cavity; calyx, small, closed, set in a narrow, superficial basin; core, small; seed, grey, small, narrow, acute, one-third, one-sixth, one-eighth; flesh, tender, fine texture, juicy, fragrant; flavor, delicate and fine; quality, *very good* or *best;* maturity, eaten middle of January.

White Spitzenberg—from Edmund Reckseeker, of Nazareth. Size, medium, two and five-eighth inches by three; form, roundish, oblong; skin, yellow, interspersed with large, grey dots, becoming smaller and more numerous toward the crown, with a blush on the exposed side; stem, nine-sixteenths by one-tenth inches, inserted in a moderately deep, open cavity, lined with green russet; calyx, small, closed, set in a shallow, narrow basin; core, medium; seed, grey-brown, short, broad, acute, one-quarter, one-fifth, one-eighth; flesh, breaking, sufficiently juicy; flavor, sub-acid, with agreeable aroma; quality, *very good*; maturity, eaten January 27th.

The *Quaker Apple*—from the same source. Size, small, two inches and three-sixteenths by two five-eighths; form, roundish; skin, striped and mottled with red carmine, interspersed with light-colored dots, more numerous and larger toward the crown; stem, long, very slender, nine-sixteenths by one-seventeenth of an inch, inserted in a very narrow cavity; calyx, large, set on a plain, plaited surface; no basin; core, medium; seed, brown, rather large, acute, three-eighths, two-eighths, one-eighth; flesh, tender, fine texture, and juicy; flavor, pleasant; quality, *good*, if not *very good;* maturity, eaten January 28th.

The *Hughes Apple*—from Thomas Hughes, of Moorestown, who found the tree growing in the woods in Middletown township, Berks county, some years ago, and transplanted it on his sister's premises; said to be an abundant bearer. Size, large, two and five-eighth inches by three and a quarter; form, roundish; skin, greenish-yellow, with a blush; sometimes quite a high-colored cheek on the exposed side, a few green blotches, some scarlet spots, and numerous grey dots, which, as they approach the basin, become more numerous, but lose their roundish character, and assume the form of short, interrupted lines, parallel to the basin, like those in the Fall Pippin. Stem, variable in length, and slender, five-sixteenths to five-eighths by one-twelfth, inserted in a moderately deep, open cavity; calyx, large, open, set in a wide, deep, sometimes plaited basin, very similar to that of the Fall Pippin; core, under medium; seed, greyish-brown, medium, oval, acute, variable in size and form; flesh, fine texture, tender, juicy; flavor, very agreeable, saccharine, without being sweet, with a delicate and delicious aroma; quality, *very good*, if not *best;* maturity, eaten March 4th to April 15th.

The *Kelsey*—fifteen years old, and stands on the premises of John Kelsey, Lower Wakefield township, Bucks county; size, two and one-eighth inches by two and five-eighths, roundish-oblate, sometimes inclining to conical; skin, greenish-yellow, occasionally with a faint blush, and numerous grey dots, a few of which have a red margin; stem, one-half by one-twelfth inches, inserted in a deep, moderately open cavity; calyx, closed, set in a very shallow, plaited basin; core, small; seed, greyish-brown, long, acuminate, three-eighths, one-sixth, one-eighth; flesh, tender, fine texture, greenish-white; flavor, mild and exceedingly pleasant, fragrant aroma; quality, *very good;* maturity, eaten March 28th.

The *Baer Apple*—from Charles Kessler, Reading, Berks county; size, under medium, two and five-sixteenth inches by two and five-eighths; form, roundish-oblong; skin, mottled with red, and striped with dark-crimson on a greenish-yellow ground, and marked with numerous grey dots; stem, one inch by one-twelfth, inserted in a wide, deep cavity; calyx, closed, set in a moderately wide, shallow, plaited basin; seed, greyish-brown, short, broad, acute; flesh, tender, fine texture; flavor, pleasant; quality, *very good;* maturity, eaten April 15th.

The *Ewalt Apple*—from E. A. Vickroy, of Johnstown, who says this variety originated more than 60 years ago, on John Ewalt's farm, 3 miles west of Bradford, on the Glade road, and Pittsburg turnpike. Size, full medium, two and a half inches by three; form, truncated, and somewhat angular; color, greenish-yellow, with a bright-red cheek, and many greenish-russet spots, especially about the base; stem, very short, rather stout, inserted in a narrow, not very deep cavity; calyx, closed, set in a narrow, moderately deep, slightly-plaited basin; core, medium; seed, small, short, plump, pointed, greyish brown; flesh, fine texture, tender; flavor, sprightly and pleasant, with an exceedingly fragrant odor; quality, *very good;* maturity, eaten April.

The *Jackson Apple*—original tree on the premises of James M. Jackson, of Quakertown, Richland township, Bucks county. Size, medium, two and one-half inches by three and one-fourth; form, roundish; skin, greenish-yellow, with many dark-green blotches, and grey dots, a few very faint-red stripes, scarcely perceptible, and, on the exposed side, a warm, mottled-brown blush, containing numerous white dots, with a central grey speck in each; stem, variable, from three-eighths to seven-eighths long, one-sixteenth thick, inserted in a deep, narrow cavity; calyx, closed, set in a moderately wide and deep, sometimes slightly-plaited basin; core, medium; seed, grey, five-sixteenths, three-sixteenths, two-sixteenths; flesh, greenish, fine texture, tender, juicy; flavor, deliciously aromatic; quality, *very good,* perhaps *best;* maturity, October to May, eaten April 4th, and May 9th. Specimens presented and grown by Wilson Dennis, of Applebackville, Bucks county.

The *Barbour Apple*—originated with J. Barbour, of Columbia, Lancaster county. Size, medium, two and five-sixteenths by two and eleven-sixteenths; form, roundish-oblate, inclining to conical; skin, mottled and striped with red of different hues, on a greyish ground, with numerous grey specks, each containing a russet dot; these specks diminish in size, but increase in numbers as they approach the calyx; stem, one-half inch long by one-tenth, fleshy at its junction, with the wood inserted in a moderately deep, rather narrow cavity; calyx, small, closed, set in a shallow, plaited basin; core, large; seed, greyish-brown, three-eighths, one-fifth, one-eighth; flesh, yellowish-white, tender texture, juicy; flavor, pleasant; quality, *very good.*

The *Dick Seedling*—originated with Mr. Richard Downing, near Downington, West Whiteland township, Chester county. Size, medium, two and a half inches by three; form, truncated, ovate; skin, striped, and mottled with crimson, on a greenish-yellow ground; stem, somewhat variable, from one by one-eleventh, to three-fourths by one-eighth, inserted in a deep, narrow, sometimes wide cavity; calyx, closed, rather small, set in a wide, moderately deep, sometimes plaited basin; flesh, fine texture; flavor, sub-acid; quality *good;* maturity, August.

The *Reist*—from a large tree on the premises of Mr. Simon S. Reist, within a few miles of the city of Lancaster; the tree is believed to be a seedling; the specimens were sent by Mr. Casper Hiller. Size, large, three and one-eighth by three and five-eighth inches; form, roundish, ribbed at the apex; skin, fair, yellow; stem, five-eighths by one-eighth, inserted in a narrow, moderately deep cavity, with some stellate russet rays; calyx, small, closed, set in a narrow, contracted, ribbed basin; core, medium; seed, small, brown, acuminate, defective; flesh, fine texture; flavor, pleasant; quality, *very good;* maturity, eaten August 15th.

The *Gewiss Good*—from Charles Kessler, of Reading. Size, below medium, from two and one-fourth inches by two and five-eighths, to two and one-fourth by two seven-eighths; form, roundish-oblate; skin, yellow, with a carmine cheek, which sometimes terminates abruptly, and occasionaly one or more white blotches in the red; stem, one-half to three-fourths by one-eleventh, inserted in a deep cavity; calyx, small, closed, set in a contracted, plaited basin; core, rather large; seed, large, short, plump, ovate, brown; flesh, fine texture, tender; flavor, sprightly, with pleasant aroma; quality, *very good;* eaten November 1st.

The *Chester Apple*—originated on the farm of William Harding, of Londonderry township, Chester county. The tree stands in a large orchard of seedlings, from the woods and fence rows, planted by a person whose name was Cook. Specimens from Thomas Harvey through Josiah Hoopes. Size, above medium, two and nine-sixteenths by three and a half; form, roundish-oblate; skin, yellow, with a crimson blush, numerous carmine dots, and a warty excrescence near the basin; stem, short and slender, three-eighths by one-tenth, inserted in a wide, not very deep, cavity; calyx, medium, set in a very wide, deep basin; core, small; seed, greyish-brown, broad, obtuse; flesh, tender, white; flavor, agreeable aroma; quality, *very good;* maturity, eaten November 21st.

The *Madison Red*—from Washington, Pennsylvania. Size, three by three and three-fourths; form, roundish; skin, striped with red of different hues, with many russet spots and dots; stem, inserted in a deep, moderately wide, russetted cavity; calyx, small, set in a medium-sized basin; core, medium; seed, destroyed; flesh, tender, fine texture, juicy; flavor, pleasant; quality, *good*, if not *very good;* maturity, eaten November 21st.

The *Seedling Paul*—from Washington, Pennsylvania. Size, two and five-eighths by three and three-fourths; form, roundish-oblate, compressed at the sides; skin, striped with red on a yellow ground; stem, short, slender, inserted in a narrow, not very deep, cavity; calyx, small, set in a narrow, shallow basin; core, small; seed, grey-brown, small, slender, acuminate; flesh, tender, fine texture, juicy; flavor, agreeably sub-acid; quality, *very good;* maturity, eaten November 21st.

The *Old House Apple*—from the premises of John Cauffman, of Mosalem creek, Richmond township, Bucks county, sent by Mr. Kessler. Size, two and one-fourth by three; form, oblate, inclining to obconic; skin, yellow, with a blush on the exposed side; stem, one-half inch by one-tenth, inserted in a moderately wide, not very deep cavity; calyx, medium, closed, set in a wide, deep basin; core, medium; seed, brown, large, short, broad, obtuse, three-eighths, one-fourth, one-seventh; flesh, tender, fine texture, juicy; flavor, agreeable aroma; quality, *very good*, if not *best;* maturity, eaten December 11th.

The *Staudt Apple*—from Mr. Kessler, grows on the premises of Mr. Staudt, of Berne township, Berks county, is believed to be a seedling. Size, large, two and seven-eighth inches by three-fourths; form, roundish, inclining to conical; skin, deep-crimson, with stripes of paler red, and numerous light dots; stem, one-half inch long, one-eighth thick, inserted in a wide, deep, russetted cavity, the russet extending in rays some distance beyond the cavity; calyx, small, closed, set in a narrow, shallow, furrowed basin; core, small; seed, light, brown, short, broad, plump; flesh, fine-grained, tender, white; flavor, sub-acid and pleasant; quality, *very good;* maturity, eaten December 26th.

PEARS.

The *Mather Pear*—originated with John Mather, near Jenkinstown, Abington township, Montgomery county, from seed planted by him 35 or 40 years ago. Size, below medium, two and one-fourth by two; form, obovate; skin, yellow, with occasionally a mottled-red cheek, and russetted at the insertion of the stem; stem, three-fourths by one-sixth, inserted obliquely by fleshy rings without depression; calyx, medium, set in a narrow, very shallow basin; seed, black, ovate; flesh, a little coarse, but buttery; flavor, delicate and pleasant; quality, perhaps, *very good;* maturity, eaten on the 5th of August.

REPORT FROM DELAWARE.

BY L. P. BUSH, OF WILMINGTON.

The northern county of Delaware (New Castle) is favorable to most fruits of a temperate climate, which require a good loam and a heavy substratum. Pears, apples, and cherries, among orchard-fruits, are very delicate and long-lived; while peaches and apricots,

though productive, are uncertain bearers and short-lived. This State, however, within a few years, has obtained a wide reputation for its peaches; which, nevertheless, require constant attention and renewing; and they have well repaid the energy and care of the cultivation.

Nectarines become a prey to the curculio, and are not worth culture in the open air; and plums are not at all reliable for the same reason. Planted in a pavement, plums are believed to be free from the depredations of this insect.

Besides, we are not far enough south to secure us from the extreme changes of the climate, which ranges from 8° F. below zero to 100° above that point. The lower counties have a temperature somewhat modified by the proximity of the ocean, and have a lighter soil, Sussex being quite sandy. This county anticipates New Castle in the spring about one week. No considerable attention, however, has been paid to fruit-culture, in its highest character, until quite recently; but market facilities, in a few years, will bring reports of a very different kind from those of the past; showing, I have no doubt, the value of their climate and soil in the cultivation of the peach, grape, apple, pear, strawberry, and other fruits of this zone.

Mr. Edward Tatnall, of Brandywine, has kindly aided me by furnishing the following critical and valuable paper, which forms an appendix to his report made to this society in 1852, and which, together with that of Dr. Brincklé, of Philadelphia, contains some of the results of his experience for fifteen years as an indefatigable amateur fruit-culturist:—

Summer Pears.

Of the summer pear, I consider the Bartlett as by far the most valuable on account of its large size, uniform productiveness, hardiness, and thrifty growth, although not of the highest flavor.

Dearborn's Seedling—is also valuable for its profuse yield, rapid, strong growth, fine flavor, and is particularly adapted to the wants of the million, (who know little of the process of house-ripening,) on account of its never rotting at the core, however ripe, and its persistence, resisting the strongest wind.

Tyson—is a pear which will rank as *best;* an upright, strong grower, but late coming into bearing.

Doyenné d'Été—is a beautiful and early variety, of excellent quality, profuse bearer, very desirable.

Manning's Elizabeth—a very handsome, small pear, nearly round; clear yellow, with a red cheek; saccharine; admired by lovers of sweet pears.

Ott—though small, is delicious. Fruit, larger and better on quince stock.

Brandywine—nearly equal in its best state to Tyson; slightly more acid, and lacking the bouquet of the latter. A strong, upright grower on pear and quince, and productive.

Souveraine d'Été—a rapid grower on quince; making a handsome pyramid, but of rather poor quality. Fruit, medium size, watery, gritty at the core. Reported by me in 1852 as a poor grower, which, I presume, was accidental.

Osband's Summer—has disappointed me more than all others. The grafts were obtained through the kindness of Mr. Barry, and, having fruited this year, proved true. It is very handsome, but perfectly worthless and insipid. This pear has a high character in Western New York, which I had supposed would be improved in our southern latitude. I may have reasons in the future for reversing the judgment given above.

Belle de Bruxelles—a large, fine-looking and productive pear; devoid of flavor.

Bloodgood—fully maintains its former character.

Bonne d'Ézée—the first year of fruiting with me (1852) was small and insipid; since that time it has borne large, fine fruit, of excellent quality, but a little disposed to crack. Bark rough.

Madeleine—is the earliest good pear; is tolerably fair in size and appearance; quality, *very good.* Strong grower on pear, poor on quince.

Kirtland's Beurré—a good grower, productive; fruit, handsome russet, with a red cheek. Quality, *very good;* but does not maintain its northern reputation.

Canandaigua—which is with me a summer variety, is very fair in quality, though inferior to Bartlett. It grows vigorously on quince. Fruit rots badly before mature.

Beurré Goubault—fine flavor and buttery, but gritty at the core; very productive.

Doyenné Boussoch—with me, a late summer or early autumn variety; is large and fine, nearly equalling Doyenné Blanc in quality. It, however, falls prematurely. A fair grower on quince, but cracks in the bark.

Several of the earlier varieties of what are commonly considered as autumn pears mature late in summer; some of them with or before the Bartlett.

Ananas—proves identically with Henry Fourth.

Beurré Bosc—maintains the highest reputation given it by authors, and is well worthy of general cultivation. Does not succeed on quince. One tree thus worked is but a foot and a half high, and struggling for existence, whilst other free-growing sorts have attained 10 feet.

Fulton—is very productive and hardy; of good medium size, but deficient in flavor.

Hewes—a seedling of this place; is worthless.

Jalousie de Fontenay Vendée—productive; a moderate grower on quince. Fruit, above medium, more or less russetted; quality, *very good.*

Épine Dumas—on first fruiting was utterly worthless, watery and insipid. Subsequent fruitings have proved it an excellent pear, comparing, in most respects, with Beurré d'Anjou.

Pie IX.—a vigorous grower on pear and quince; fruit, full before mature; not tested.

Beurré Benoist—grows well on quince, and makes a good pyramid. Fruit, medium size, roundish; of *very good* quality.

Johannot—a pear under medium; yellowish-green, with knobby processes at stem. *Very good;* growth, moderate.

Lodge—ripens late in summer; fully equals Brown Beurré. Vigorous and productive on pear stock; not tried on quince. Its large size and excellent quality recommend it to all lovers of sprightly pears.

Vezouziere—an irregular-ridged pear. *Very good*, nearly *best.* Productive and thrifty on the pear.

Onondaga—first fruited the present season; is very vigorous and productive on pear. Young shoots subject to blight on quince. Fruit, not mature.

Brown Beurré—is too well known to need description, and is highly esteemed for its rich vinous flavor.

Paradis d'Automne—a vigorous, straggling grower, moderately productive; *very good.*

Buffum—a strong, vigorous, upright grower on quince. Fruit, nearly equal to Doyenné Blanc, but subject to specks on the tree before maturity.

Baron de Mello—productive and vigorous on quince. First fruited this season; quality, *good;* may be *very good* with more age.

Dix—a very tardy bearer, but rapid grower, with slender, upright shoots, and has continued to grow; no fruit.

Long Green—appears to be a meaningless title, there being at least two varieties under that name, one of *very good* quality, the other worthless. Unfortunately, I possess the latter.

Urbaniste—like Dix; growth, vigorous, making a fine pyramid, without extra care. No fruit.

Jersey Gratioli—is a pear of much merit. Fruit, above medium; juicy, melting, rich; moderatively productive. Bark, rough and cracked.

Belle Lucrative—is variable on good soils, mostly *best;* sometimes poor. Young shoots, subject to blight on quince.

Doyenné Robin—a bergamot-shaped pear, medium size; quality, *very good;* productive, and tolerably thrifty on quince.

Nouveau Poiteau—a most robust grower on quince; shoots remarkably strong and upright. Tolerably productive, bearing in clusters on old wood. Fruit, quite large, somewhat russetted; not yet mature.

Oswego Beurré—a strong, upright grower on quince. Productive, but nearly valueless with us; shedding its fruit before fully grown.

Rodney—is a seedling from Sussex county, and is only valuable on account of its remarkable affinity for the quince, on which it makes a monstrous growth. Desirable for double working.

Winter Pears.

Of winter pears, it may be well to say that Beurré d'Aremberg has entirely failed on quince.

Beurré Easter and *Beurré Gris d'Hiver Nouveau*—may be placed in the same category, as shy bearers and good growers on the quince.

St. Germain—may be ripened finely by leaving it in a bed of leaves under the tree until early winter.

Soldat Laboureur—has disappointed all its admirers; although large and promising, it never performs, but invariably falls before mature. It makes one of the handsomest pyramids in the fruit-garden, though the bark is rough and unsightly.

Wollaston—has proved to be Glout Morceau, as suspected by several cultivators to whom scions had been sent.

Suzette de Bavay—although a fine, thrifty grower on quince, at first, is not durable with me. I never succeeded in keeping it more than five years.

Catillac—is valuable as a cooking pear on account of its large size, productiveness, and durable quality.

Columbia—is productive and thrifty, but the fruit has a tendency to rot on the tree.

Echasserie—better known with us as the Walnut Pear, is a very productive variety, easily ripened, and of good quality.

Prince's St. Germain—is a thrifty grower on quince, a tardy bearer, not having yet fruited, although over seven years planted.

Many of the newer sorts are fruiting this season, for the first time, among which I esteem the Graslin as one that bears marks of excellence. It is not yet mature.

It gives me much pleasure to be able to bring to your notice the following seedling pears, all of decided excellence: Richards, Catharine Gardette, and Wilmington.

The first was originated by Mary Richards, and takes its name from the originator. The accompanying description is by Dr. Brincklé.

Richards' Pear.—This fine pear originated on the premises of the late Nathaniel Richards, northwest corner of 4th and Shipley streets, Wilmington, Delaware. Fruited in 1852 for the first time. Size, medium, three inches long by two and five-eighths broad; form, roundish, pyriform; skin, yellow, with many minute russet dots, and slightly russetted at the base; stem, seven-eighths of an inch long, by one-sixth thick, inserted obliquely by a fleshy termination, without depression; calyx, small, open, set in a contracted, narrow, shallow basin; core, medium; seed, brown, ovate, with an angle at the obtuse end, three-eighths of an inch long, one-fifth wide, one-eighth thick; flesh, greenish-white, granular around the core, buttery, melting and juicy; flavor, vinous; quality, *very good;* maturity, last of September.

The others were grown from seed by Dr. Brincklé, who furnished the annexed descriptions:

Catharine Gardette Pear.—At the Pennsylvania Horticultural Society's Exhibition, in September, 1845, the seed of the best pears cut

by the Fruit Committee were saved and planted in the spring of 1846. The Catharine Gardette originated from one of these seeds. The original tree will not fruit for many years to come; but a graft taken from it was worked on quince in 1850, and fruited in 1855, for the first time.

The foliage is characterized by being much waved; young shoots, short-jointed, yellow-olive on the shaded side, brown-olive on the side exposed to the sun, with many minute, white dots; buds, pointed. Size, above medium, two three-quarter inches long by two five-eighths broad; form, roundish, obovate; skin, fair, yellow, with numerous small carmine dots on the exposed side; stem, an inch by one-seventh; curved, inserted by a fleshy termination into a slight depression; calyx, small, set in a rather deep, regular basin; core, medium; seed, dark, flat, large, seven-sixteenths of an inch long, one-quarter wide, one-eighth thick, with an angle at the obtuse end; flesh, fine texture, buttery; flavor, delicious, with a delicate aroma; quality, *best;* maturity, beginning of September.

Wilmington Pear.—This is a seedling of the Passe Colmar, from seed planted in the spring of 1847. Like the Catharine Gardette, the original tree will not fruit for several years. A graft was worked on quince in 1850, and fruited in 1855. A specimen was examined by the Committee on Native Fruits of the American Pomological Society, at their late session at Rochester. Size, medium, two and eleven-sixteenth inches long by two and a half broad; form, obtuse, pyriform, somewhat compressed at the sides; skin, cinnamon-russet, with patches of greenish-yellow on the shaded side, and faint traces of carmine on the exposed part, with sometimes a number of black dots surrounded by a carmine margin; stem, somewhat variable, one and a quarter inches to one and a half by one-eighth to one-sixth, of a cinnamon-color; curved, inserted obliquely in a small cavity; calyx, medium, with short, erect segments, set in a wide, rather deep basin; core, medium; seed, dark-brown, acuminate, with an angle at the obtuse end, three-eighths of an inch long, three-sixteenths wide, one-eighth thick; flesh, of fine texture, melting and buttery; flavor, exceedingly saccharine, with the delicious aroma of the Passe Colmar; quality, *best;* maturity, middle of September.

Apricot.

The *Holden*—was grown from a seed of the Moorpark by Mrs. Eliza Holden, at the northwest corner of 5th and Tatnall streets, Wilmington, and called after her.

Dr. Brincklé, to whom specimens of the fruit were sent, has kindly furnished the following description: "Size, one and five-eighth inches long, one and seven-sixteenths broad, one and a half thick; form, roundish, with a suture extending from the apex to the base; skin, yellowish, with a few red points, and some russet blotches; cavity,

medium; stone, seven-eighths of an inch long, three-quarters wide, one-half thick, perforated; flesh, yellow; flavor, fine, saccharine; quality, *best;* maturity, eaten August 2d, 1852." The original tree is now dead.

APPLES.

The *Rebecca Apple*—originated about two miles northeast of Wilmington; it was first brought into notice by J. P. Jeffries, in that vicinity, and named after his lady, Mrs. Rebecca Jeffries. The description which follows is from the pen of the same distinguished pomologist as the preceding:—

The Rebecca apple originated with J. P. Jeffries, of Honeycomb, near Wilmington, Delaware, and is probably an accidental seedling of the Maiden's Blush. Size, large, two and three-quarter inches long by three and a quarter broad; form, roundish, oblate; skin, greenish-yellow, sometimes a faint, mottled-orange and red blush, occasionally a deep crimson blush on the exposed side; stem, very short, thick and fleshy at its connection with the branch; cavity, deep, narrow; calyx, large, closed, set in a wide, deep, regular basin; core, medium; flesh, fine texture, and sufficiently juicy; flavor, agreeable; quality, *very good;* maturity, eaten middle of September, 1856.

The cultivation of the apple, as in most other sections, has been much neglected. It is true, trees innumerable have been planted, but they have been put in, much in the same way as posts in a fence; the main object being to place them in a line. There is this difference, however, the holes in which the trees are intended to be planted are scooped out in the form of a wash-basin, whilst the post has a hole with perpendicular sides. The post, too, is entirely buried at the bottom, whilst the end of the roots in the tree are left peering above ground, like pickets around a garden.

The planting over, all is done; no stakes are driven; for, surely, the tree is strong enough to support itself. The next thing is to lay the orchard down in grass, and after the first mowing, it makes an excellent run for calves. After this extra cultivation, those varieties which do not succeed, are condemned as worthless.

SUMMER APPLES.

Early Harvest, Sweet Bough, American Summer Pearmain, Summer Rose, Early Strawberry.

AUTUMN APPLES.

Kane, Rambo, Smoke House, Fall Pippin, and Maiden's Blush.

Winter Apples.

Baldwin, Cart House, or Gilpin, in some localities; Newtown Spitzenberg, Hayes Apple, Winesap, Bullock's Pippin, or Sheep's Nose, Cumberland Spice, Lady Apple, Green and Yellow Newtown Pippins, and Smith's Cider. Rhode Island Greening rots on the tree. Yellow Belle-fleur drops prematurely.

The *Smoke House*—is a very valuable late fall fruit, keeping into early winter; cooks well when half grown.

Apricots.

The best in cultivation is the Moorpark, which is generally known.

Hemskirke—is smaller than the preceding, softer in flesh, and a few days earlier.

Red Masculine—is much inferior to the above, bears large crops, which are less subject to attack by the curculio.

Burlington—is a hardy, free grower, but recently introduced, and has not yet fruited.

The apricot requires a northern exposure to retard its growth in the spring, and will seldom perfect any fruit, unless set in a pavement.

Grapes.

The *Catawba* and *Isabella*—are the two varieties most generally cultivated, and usually yield abundant crops, ripening well.

The *Bland* or *Powell*—has a higher flavor than either of the above, but is neglected on account of the thin bunches and many imperfect berries.

The *Elsinborough*—is also widely distributed, and is generally regarded as a superior grape. The objection is its size.

The *Ohio*, *Missouri*, *Herbemont*, *Diana*, and *Clinton*—are being introduced, as yet, sparingly.

The last-named matures about the 1st of September; it is in some localities quite sweet, and *very good;* the Ohio is less hardy than any of the others named, being sometimes entirely winter-killed in this latitude.

A variety of the common Summer Grape, (*Vitis æstivalis,*) is occasionally found wild along the Brandywine creek, which compares favorably, except in size, with the Isabella. Attempts have been recently made to improve it by cultivation, with what success, has not been made known.

Raspberries.

The *American Red*—native of the Pokone Mountain, and the Northern and Eastern States, is the market raspberry of this vicinity. No other is shown for sale, except an occasional lot of the common Black Cap, or the White Cap of the woods.

The *Red* and *Yellow Antwerp*, *Franconia*, *Fastolff*, and *Catawissa*—are sparingly cultivated by amateurs, some of whom have secured most of the new and valuable seedlings originated by Dr. Brincklé.

Quinces.

The *Orange* or *Apple*—is the only variety known, and even that is neglected on account of the depredations of the borer.

Peaches.

Serrate Early York, Large Early York, Red Rareripe, George IV., Oldmixon, Free and Cling, Ware, Late Free, Rodman's Cling, Smock's Free, La Grange, Early and Late Crawford, Cole's White Melocoton, Yellow Rareripe, and Heath Cling are very generally cultivated and all more or less esteemed. Morris White is usually bitter and unpalatable.

Early Tillotson—is so affected by mildew as to prevent growth, and seldom perfects its fruit. It seems to require a very light soil.

Plums.

An occasional year gives us a small return from the Washington, (which, however, rots on the tree,) Green Gage, Coe's Golden Drop, and Huling's. The newer varieties have been very little planted.

Apples.

Mr. John Diehl, of Delaware city, has furnished a brief, but excellent, report upon apples. It is the result of his own observation, and is very satisfactory.

Heretofore, the renewing of old orchards by planting new ones to take their places, has been much neglected in this region. But a change has infused itself into the spirit of the people; we now have a great many young orchards coming on, and some of them of large extent, so that in a few years we may flatter ourselves with having fruit in abundance. This region is as well adapted to the growth of the apple, as any other, perhaps, in the United States.

One objection to a great many of the winter varieties introduced from the North is, that they mature too soon with us, some of them being nothing more than late fall varieties.

Summer Varieties.

Early Harvest—is considered our best summer apple, a long time in cultivation in this part of the country.

Early Lippincott—we consider our next best summer apple, ripening gradually on the tree, and being a long time in use.

Summer Pearmain—is the best apple of its season, being a late summer variety.

Large Bough, *Early Red Margaret*, *Early Redstreak*, *White Juneating*, and *Summer Queen*—are all good varieties, but we deem the three preceding the best.

Caleb Apple—is a fine, sweet variety, a good deal on the order of the Early Bough, but an apple I prefer to that variety.

Fall Varieties.

The *Smoke House*—is growing more into favor, as it becomes known; a straggling grower, but fine for either dessert or kitchen.

The preceding, with the Fall Pippin and Rambo, we consider the three best fall varieties.

The *Porter*—has borne with us this season for the first time; it is a straw-colored variety, of attractive appearance and fine quality, ripening about the 1st of September.

The *Cumberland Spice*—with me, is a first-rate fruit.

The *Belle fleur*—requires to be planted on a light, dry soil, or it will not give satisfaction.

The *Northern Spy*—has now fruited with me for two years; so far, it has proved a fine, large, fair variety, and not liable to the objections I have heard urged against it.

The *Jonathan*—I have had in bearing for several years; it is hardly distinguishable from the Winesap in appearance; but I think will prove a better apple.

Turn of Lane—a native of New Jersey, is a variety which I see but very little said about, but one we esteem highly; it is a rather small, red-striped apple, very perfect, tender, and of a fine flavor.

The *Cart House*—for the two past years, has been more perfect; it is an apple of fine quality, where it does well.

The *Roman Stem*—I should pronounce a first-rate apple in our soil.

Winter Varieties.

The *Paradise Winter Sweet*—a native of Pennsylvania, a very perfect apple, and a good keeper, of fair quality.

The *Newtown Pippin*—does fine in this part of the State; it is without an equal in its season, that is, late winter and spring.

In a brief reply to my interrogatories by Mr. John C. Clark, of the neighborhood of Delaware city, he says: "Our soil, (which is that of most of the county,) is a strong loam, and, when well limed or marled, always produces, with good culture, liberally of all standard fruits.

"The most profitable fruits, as yet cultivated, are peaches, apples, pears, and quinces.

Apples.

"Among the condemned apples are the Long Pippin, Vanderveer, Romanite, Redstreak, Gregg, Rusticoat, Grey House, and Grindstone.

"Of the superior kinds of apples are, Hayes Apple, Lady's Blush, Lippincott's Early, Sweet Bough, Roman Stem, Cumberland Spice, Grigson, Newtown Pippin, Green Newtown Pippin, Ohio Pippin, and Belle-fleur.

Peaches.

"Of the peaches are, Early York, Troth's Early, Melocoton, Ward's Free, Crawford's Late, Rodman, Smock, and Heath. All fine and reliable here.

"The blight or the yellows in peaches is the most troublesome; excepting this, the above-named fruits are but little liable to disease."

Grapes.

The only satisfactory experiment in this State, so far as I know, with foreign grapes, under glass, has been made by Mr. Joseph Shipley, in the northern part of this county. He has grown, with abundant success, the White Muscat of Alexandria, Black Hamburg, and Grizzly Frontignan—his fruit having matured perfectly without injury from mildew. He uses culinary heat, and his vines have the careful attention of an experienced gardener.

In another house, situated in Wilmington, the same experiment has been tried, but with less success, as is believed, from two causes, the want of a well-ventilated location and experience. The mildew attacked the fruit annually, the Muscats especially, which cracked open and rotted. The Chasselas varieties and the Black Hamburg were less liable to this disease, under the same deficient culture. In the same house, where artificial heat was formerly used, it has been laid aside for two years, and ventilation kept up in a slight degree at night, which was not formerly the case. The vines now produce freely, and are free from mildew. It is true, that sulphur is sprinkled over the floor several times in the summer, but this was also the fact when the forcing process was followed, and without effect.

Last winter, the vines were caught on their rods by the thermometer at zero; but they lost but little matured wood, and are bearing freely this year—an unexpected result, truly.

It is evident from this trial, that out-door culture of these varieties of grapes fails from the mildew; and it is also equally evident that, with a very moderate amount of attention, and without artificial heat, the Black Hamburg, Alicante, White Buel, Rose Chasselas, Golden Chasselas, Muscat Blanc Hâtif, and probably the White Muscat of Alexandria could be successfully cultivated, so as to repay the care of an amateur, or of a horticulturist.

Within a few days, I have met with a white native grape, introduced into Wilmington from Chester county, Pennsylvania, which I consider well worth notice. It is a good bearer, the bunches, in general appearance, resembling the Catawba, but more shouldered, full, yet not crowded with berries, which are nearly as large as the Catawba, globular, green, and, when the bloom is off, somewhat bronzed; with musky flavor, rather stronger than Isabella, rather more pulp, and nearly equal to it in sweetness. The berry is translucent, the seeds being distinctly seen. The vine is hardy; its leaves resembling the Catawba, being large, cordate, coarsely serrate, approaching trilobate, downy on the under side.

In addition to the above grape, there are two other varieties of seedlings indigenous to this State or neighborhood, which have respectively received the appellation of Delaware Burgundy and Canby Grape; the former, a seedling from Miller's Burgundy; the latter, most probably from the Isabella.

REPORT FROM MICHIGAN.

BY DANIEL K. UNDERWOOD, OF DETROIT.

That portion of Michigan, in which the cultivation of fruit has made any considerable progress, is embraced between 41° 40′ and 43° 30′ north latitude, and bounded east by Lake St. Clair, Lake Erie, and the Detroit, and west by Lake Michigan. This territory consists of two slopes, the eastern, the waters of which pass into Lakes Erie and St. Clair, and the western, (which is much the largest,) which discharges into Lake Michigan. At the eastern border, the country is flat for several miles in width. Going westward, the surface is more and more undulating, until the dividing ridge or watershed is reached, where an altitude of 500 feet above Lake Erie is attained; thence the land slopes gently westward to Lake Michigan. There is great diversity of soil in the territory just described, varying from a stiff, tenacious clay, through clayey loam, gravelly loam, sandy loam, to light sand, and frequently nearly all these varieties may be found on a single farm of moderate dimensions. Prairies, (limited in extent, compared with those in the more Western States,) are frequently met with, particularly in the western part of the State. But the greater portion of this part of Michigan was either heavily timbered, or consisted of what is known in the West as, "oak openings." The climate of that portion, lying adjacent to Lake Michigan, is believed to be favorably modified for fruit-growing by the vicinity of that large body of water; and, perhaps, the same may be true of that portion near Lakes Erie and St. Clair. The changes of temperature in this territory are believed to be more sudden and extreme than in the same latitudes on the Atlantic coast. Lime is abundant in all our soils, except, perhaps, the light sand; deposits of marl are very common. From the newness of our soils, it can hardly be supposed they are deficient in potash. Although fruit-trees grow well in all which are not too wet, yet, if one were to select a soil the best adapted to all varieties of fruit, taking into consideration healthiness of the trees, size and quality of the fruit, productiveness and immunity from insects, I should choose a gravelly, clayey loam. This variety of soil, with its clayey subsoil, is largely supplied with lime. In the warm, sandy soils, the apple-tree grows very fast, but, with the exception of a few varieties, the fruit is inferior in flavor, if not in size, to that grown on heavier soils. On the warm soils, pears come into bearing sooner, and ripen their fruit earlier than on clay; but the fruit is generally inferior in size and quality, and the trees less vigorous. Plums are very short-lived on sandy soils, and it is next to impossible to save any of the fruit from the curculio. Cherries, especially the Hearts and Bigarreaus, grow very fast in sandy soils, but they are more liable to "bursting of the bark," than on dry clayey loams. Peaches are more liable to the ravages of the borer, and

shorter-lived in light soils, than in heavy, provided the last is sufficiently dry ; the fruit may be larger in the former, but is higher flavored in the latter. In the vicinity of Detroit and Monroe are many old orchards of apple and pear-trees, planted by the early French settlers, which are still, at the age of a century or more, vigorous and productive, and show unmistakably the strength of the soil, as they have received little or no attention from their owners, the French Canadians being most careless cultivators. With the exception of these, our oldest orchards are not much above 30 years old. Planted in a virgin soil, rich in mineral matter and the accumulated vegetable deposits of centuries, our fruit-trees are generally in the most vigorous condition, and have neither needed, nor received, an extensive application of manures. The superior quality of our apples, thus far, is due more to the soil and climate, than to any careful cultivation. We are pleased to be able to say, there is, among all classes of our people, an increased attention to fruit-culture, and a careful inquiry for the best varieties. We believe Michigan is destined to be one of the great fruit-growing States ; and we shall rejoice if our labors should contribute, in the smallest degree, to further the objects of the society, from which we have received our commission.

Summer Apples.

American Summer Pearmain—rare, not properly tested.

Carolina June—rare, not properly tested.

Early Harvest—sometimes small from overbearing ; Tart Bough, a sub-variety ; *very good.*

Early Joe—*best.*

Early Strawberry—very beautiful, small, juicy, but not rich ; *very good.*

Golden Sweet—valuable for domestic animals ; *good.*

Maiden's Blush—little disseminated ; a beautiful fruit ; *good.*

Red Astrachan—rather acid, tree, vigorous, good bearer ; fruit, excellent for cooking ; *very good.*

Sweet Bough—moderate bearer ; *very good.*

Sine Qua Non—not much disseminated ; *very good.*

Summer Queen—on warm soils is an excellent fruit ; *best.*

Summer Rose—*very good.*

Autumn Apples.

Alexander—large and beautiful, moderately productive, not valuable.

Daniel—not much disseminated, tree, a slender grower; *very good.*

Duchess of Oldenburg—requires further trial.

Dyer—rather tart; *good.*

Fall Pippin—best.

Fameuse—very good.

Gravenstein—best.

Hawley—has not been extensively tested in this State; *best.*

Jersey Sweet—richest sweet apple of its season; *best.*

Keswick Codlin—valuable for cooking, and a great bearer.

Late Strawberry—one of the best.

Porter—universally valued; *best.*

Rambo—very good.

Spiced Sweeting—good.

Twenty Ounce—valuable only for culinary purposes, moderately productive; *good.*

Wine—large and showy, excellent for cooking; *good.*

Winter Apples.

Baldwin—cannot be said to have been established in this State; promises well.

Belmont—best.

Black Detroit—has been known in Detroit a long time, much praised by some persons; *good.*

Blue Pearmain—flesh, dry; *good.*

Bourassa—not much cultivated; *very good.*

Cornish Gilliflower—very good.

Domine—but little known; *good* or *very good.*

English Russet—small, too short-lived from overbearing ; *good.*

Esopus Spitzenberg—large and fair, the highest-flavored winter apple ; *best.*

Green Newtown Pippin—fruit usually fair on young trees, but on light soils, soon becomes scabby, and nearly worthless.

Golden Russet—liability to shrivel injures this fruit for market ; *very good.*

Herefordshire Pearmain—overbears, and fruit becomes small ; *very good.*

Hubbardston Nonsuch—has not been extensively tried in this State.

Jonathan—not sufficiently tested to establish its character.

Ladies' Sweeting—*very good.*

Lady Apple—good keeper, tree requires high culture and thorough pruning ; *very good.*

Northern Spy—comparatively new, requires further trial.

Peck's Pleasant—not fairly tested, large.

Red Canada—bears large crops of fine fruit, every other year ; *very good.*

Rawle's Jeanet—not much known here ; *good.*

Roxbury Russet—*very good.*

Swaar—with good culture and careful pruning, maintains the high character acquired on the Hudson ; *best*

Stone—valuable as a late keeper ; *good.*

Twenty Ounce Pippin—*good.*

Talman Sweeting—*good.*

Rhode Island Greening—yields to none but Red Canada as a market apple ; *very good.*

Vanderveer—*very good.*

Westfield Seek-no-Further—*very good.*

Yellow Belle-fleur—requires careful pruning ; *very good.*

The following varieties are rejected : Black Gilliflower, Romanite, Gloria Mundi, Pennock, Fallenwalder, and Cheeseborough Russet.

Pears.

Ananas—too small for market; *very good.*

Bartlett—fruit, uniformly *good.*

Belle Lucrative—fruit, large, sometimes ten inches in circumference, generally of the very highest flavor; *best.*

Bloodgood—very good.

Beurré Diel—very good.

Beurré d'Aremberg—best.

Buffum—tree grows vigorously; *very good.*

Passe Colmar—good.

Dearborn's Seedling—very productive; fruit, uniformly fair, *very good.*

Dix—very good.

White Doyenné—very productive; never seen the fruit crack here; *best.*

Duchesse d'Angoulême—should be cultivated on quince stocks only; *very good.*

Dunmore—sometimes *very good.*

Flemish Beauty—large and splendid; *very good.*

Frederick of Wirtemberg—sometimes *very good,* often *poor.*

Glout Morceau—very good.

Johannot—very good.

Julienne—good.

Lenawee—a pear which appears to be known only in Lenawee county, Michigan, and so named by the Adrian Horticultural Society, supposed to have been introduced from Western New York, twenty-five years ago or more. Tree, a very rapid grower, hardiest of all pear-trees; fruit, medium to large size, high-flavored and juicy; when house-ripened, very productive; ripens about the 10th of August; extensively disseminated in the vicinity of Adrian, and worthy of cultivation; *very good.*

Louise Bonne de Jersey.—This and Duchesse d'Angoulême are the only varieties I should attempt to cultivate on quince stocks, with the expectation of profit.

Madeleine.—This variety and Glout Morceau are most liable to blight; *very good.*

Osband's Summer—decays very soon, is not equal to Lenawee, which ripens about the same time; *good* or *very good.*

Passe Colmar—greatly liable to overbear; fruit, needs thinning severely, or it will be worthless; *very good.*

Pound—valuable for baking; *good.*

Seckel—uniformly of the highest flavor; *best.*

Sheldon—sometimes coarse-grained and deficient in flavor; *new,* not sufficiently tested here.

Sterling.—This variety was introduced into Wayne county, Michigan, from Lima, New York, about twenty-five years ago; *very good* or *best.*

Stevens' Genessee—*very good.*

Swan's Orange (Onondaga)—an early and constant bearer.

Summer Bon Chrêtien—liable to crack and mildew.

Summer Rose—sometimes *very good;* fruit, small.

Tyson—has not been sufficiently tested to fix its character; *best.*

Urbaniste—needs further trial.

Vicar of Winkfield—*good* or *very good.*

Winter Nelis—has the same rank among winter pears that the Seckel has among the fall varieties. I have known specimens three inches in diameter; *best.*

Cherries.

American Amber—*good.*

American Heart—*good.*

Baumann's May—fruit, small; ripens 1st of June; *good.*

Bigarreau—liable to rot before ripening.

Belle d'Orléans—*very good.*

Belle de Choisy—not a good bearer.

Black Tartarian—*very good.*

Black Eagle—best.

Black Heart—a great and constant bearer; *good.*

Burr's Seedling—very good.

Belle Magnifique—very good.

China Bigarreau—good or *very good.*

Downer's Late—best.

Early Purple Guigne—one of the best early cherries; *very good.*

Elkhorn—flesh, very solid; tree, productive; *good.*

Elton—tree, hardy, very productive; one of the most valuable varieties; *very good* or *best.*

Florence—moderatively productive; *very good.*

Governor Wood—bears young; the richest cherry known here; *best.*

Kentish—valuable for culinary purposes; *very good.*

Large Heart-shaped Bigarreau—large and splendid; productive tree, rather tender; *very good.*

Louis Philippe—good.

May Duke—our most valuable cherry; *very good.*

Merveille de Septembre—good.

Napoleon Bigarreau—large, showy; tree, productive; fruit, liable to rot; *good.*

Ohio Beauty—beautiful; *very good.*

Plumstone Morello—valuable for its lateness; *good.*

Reine Hortense—not sufficiently tested to speak with certainty.

Sparhawk's Honey—a particular favorite with the birds; *good.*

Transparent Guigne—fruit, somewhat bitter.

PEACHES.

Alberge—a good bearer; *good.*

Bergen's Yellow—a shy bearer; *very good.*

Coolidge's Favorite—best.

Crawford's Early—very good.

Crawford's Late—very good.

Early Tillotson—best.

Early York (large)—not a great bearer; *best.*

Early York Serrate—best.

George IV.—a valuable bearer; *best.*

Incomparable—a cling-stone; poor bearer.

Jacque's Rareripe—very good.

Lemon Cling—good.

Large White Cling—little sought in market; *very good.*

Grosse Mignonne—best.

Oldmixon Free—best.

Red Rareripe—very good.

Red-cheeked Melocoton—liable to rot before ripening.

Sweetwater—poor bearer; *very good.*

Snow—valuable only for preserving; *good.*

Tippecanoe Cling—very late, a moderate but constant bearer; flavor, fine; *very good.*

Walter's Early—very good.

White Imperial—a good bearer; *very good.*

Van Zandt's Superb—very good.

Yellow Rareripe—very good.

Plums.

Bingham—not much known here; *best.*

Bleecker's Gage—very good.

Cherry—good.

Columbia—tree, tender; *very good.*

Coe's Golden Drop—very good.

Duane's Purple—large and showy; *good.*

Huling's Superb—a large and showy fruit, not very productive; *very good.*

Imperial Gage—very productive; *very good.*

Green Gage—unequalled in flavor; *best.*

Jefferson—*best.*

Lawrence Favorite—somewhat liable to rot before ripening; *best.*

Lombard—tree, hardy, very productive; fruit, less liable to the attacks of the curculio than most other varieties; *good.*

Mediterranean—a good plum, but more liable than most varieties to the ravages of the curculio; *very good.*

Red Magnum Bonum—*good.*

Red Gage—*very good.*

Royale Hâtive—so far, has proved worthless.

Reine Claude de Bavay—nearly equal to Green Gage; *best.*

Yellow Magnum Bonum—*good.*

Yellow Gage—best on light soils; *very good.*

Washington—*very good.*

Quinces.

Angers—used for stocks for dwarf pears.

Orange.—This is the only variety cultivated here for fruit, so far as known.

Apricots.

Black—hardy; *good.*

Breda—more hardy than most varieties; *very good.*

Early Golden—*very good.*

Large Early—*best.*

Moorpark—*best.*

CURRANTS.

Black Naples.—This variety is preferred by some intelligent cultivators to any other for making wine.

Cherry—under high cultivation, produces a small crop of very large currants of second or third quality.

May's Victoria—a poor grower; fruit, harsh in flavor, ripens late, which is its only good quality; unworthy of cultivation.

Red Dutch and *White Dutch.*—These two varieties will not be supplanted by any others now known to us; *best.*

White Grape—no larger than White Dutch; flavor not so good; *very good.*

RASPBERRIES.

Brincklé's Orange.—From an experience of two years should rank it as most productive of all raspberries; *best.*

Colonel Wilder—a light-colored fruit, superior in flavor to White Antwerp; *very good.*

Franconia—productive; more hardy than most of the large varieties; *best.*

Fastolff—not so productive nor hardy as the Franconia, but may classed among the *best.*

Knevett's Giant—very large and productive; *very good.*

Large-fruited Monthly—moderately productive; has shown no disposition to fruit monthly.

Red Antwerp—very tender; *best.*

White Antwerp—tender; *very good.*

BLACKBERRIES.

The improved "High Bush" from the neighborhood of Boston has been introduced, but some disappointment has been experienced with the fruit thus far. The "New Rochelle" has been extensively introduced into Lenawee county, and, from a limited trial, it bids fair to become one of our most valuable summer fruits.

STRAWBERRIES.

Bicton Pine—does not grow vigorously; quite tender.

Black Prince—sometimes very good, large and productive; *good.*

Boston Pine—unproductive; *very good.*

Burr's New Pine—a fruit of the highest flavor; usually bears good crops; *best.*

Crimson Cone—productive; *good.*

Cincinnati Hudson—very productive; *good.*

Dundee—very productive; *good.*

Hovey's Seedling—some seasons bears large crops; fruit, very unequal in size; *very good.*

Longworth's Prolific.—It is believed we have not the genuine.

McAvoy's Superior—fruit, almost all large, bears enormous crops, continues a long time in bearing, rather acid; *good.*

McAvoy's No. 1.—much less productive than the preceding and not so good.

Large Early Scarlet—usually bears a good crop; *verg good.*

GOOSEBERRIES.

Houghton's Seedling—does not mildew.

Of the English varieties the following are best, in the order named: Red Champagne, Ironmonger, Parkinson's Laurel, Whitesmith, Red Warrington, Early Sulphur, and Crown Bob; the last-named being most subject to mildew.

GRAPES.

Alexander—hardy; very productive. In Southern Michigan it usually ripens its fruit in sunny situations; is not recommended for general cultivation.

Catawba—does not always ripen its fruit; should be planted near a wall, or in a sunny place; best native grape; *best.*

Clinton—ripens a little earlier than the Isabella; acid and harsh, of little worth as a table grape; said to be valuable for wine-making.

Concord—not yet tested sufficiently.

Diana—new in this State; needs further trial.

Elsinborough—same may be said as of the Diana.

Isabella—uniformly ripens its fruit; productive; not so hardy as the Catawba or Alexander; vines, not unfrequently killed by a bright sun succeeding intense cold.

The culture of foreign grapes under glass has not been attempted much, except in Detroit. A few varieties are raised in open air, the vines being laid down in winter. Of these, the White Sweetwater is most common; but Royal Muscadine is best.

REPORT FROM INDIANA.

BY DR. W. T. S. CORNET, OF VERSAILLES.

The State of Indiana presents a great diversity of soil as well as climate. The central and northern portions of it have its soil in most places made up of the *diluvium*, or *drift*, from the north, which varies so much in its constituent elements, in localities in close proximity, that an apple which succeeds well on one farm is sometimes found to be of no value on the adjoining—the Rhode Island Greening, for instance. The character of the underlying rock affords no index to the composition of the soil. The southeastern part of the State has more uniformity in the constituents of its soil, having been chiefly made of the limestone which lies beneath it.

My orchard is in the southeast part of the State, on high, rolling land, near Versailles, and 50 miles due west of Cincinnati. Its geological position is near the western terminus of the blue limestone region of the West, Cincinnati being near its centre. The soil, after a few inches of vegetable mould, is a stiff, yellow clay, containing some silicious matter. The original growth of timber was beech intermixed with the sugar-maple, oak, poplar, and dogwood. The crops which succeed well are Indian corn, wheat, oats, potatoes, and the grasses, generally.

APPLES.

I have tested the following varieties of apples sufficiently to form a tolerably reliable opinion concerning them, namely: Yellow June, Prince's Harvest, Carolina Red June, Sweet June, Red Astrachan,

Summer Queen, American Summer Pearmain, Summer Pearmain of Mount Bohannan, Kirkbridge White, Maiden's Blush, Daniel Apple, Porter, Hoss, Fall Wine, Fall Pippin, Alexander, Gravenstein, Wing Sweeting, Cooper, Rambo, Black Pippin, Golden Russet, Prior's Red, White Belle-fleur, Yellow Belle-fleur, Rawle's Janet, Newtown Pippin, Belmont, Vanderveer, Michael Henry, Rhode Island Greening, Roxbury Russet, Broadwell, Winesap, President, Gloria Mundi, Pennock, Northern Spy, Tewksbury Blush, Woolverton, Limbertwig, Willow Switch, Red Sweet Pippin, Newark Ring, Red Baldwin, Minister.

From the foregoing I would recommend, as well suited to the blue limestone region referred to, the following: For July, Prince's Harvest, and Carolina Red June; for August, Bohannan, and American Summer Pearmain; for September, October, and November, Fall Wine, Fall Pippin, Cooper, and Rambo; for Winter, Rambo, Golden Russet, Belle-fleure, and Prior's Red. For long keeping, Rawle's Janet, Newtown Pippin, and Winesap. The latter deserves more attention than it receives. The fruit is not first-rate, but the tree is hardy, and bears nearly every year. The fruit does not fall from the tree, is sound, keeps long, and brings a good price in spring, when fruit becomes scarce.

Pears.

The pear tree is short-lived in this county, owing to blight and winter. He who plants a pear-orchard, and fails to continue to plant, will soon find that he has run ashore in the business; hence, there will not soon be a full supply of this fruit to accommodate the masses at moderate prices. I have tested many varieties, and experienced disappointment in many instances. Fruits of the following varieties have given satisfaction thus far: Madeleine, Bloodgood, Julienne, Dearborn's Seedling, Washington, Bartlett, Seckel, Louise Bonne de Jersey, White Doyenné, Beurré Piquery, Beurré Diel, Passe Colmar, Winter Nelis, and Lawrence.

My experience goes in favor of training fruit-trees low, for many reaonss. They resist storms better, protect their roots from the effects of drought, the bark on the trunk is not damaged by the action of the sun, and the fruit is gathered easier and cheaper. Apple and pear-trees, budded or grafted above ground, are worth more than those grafted on the root, from the fact, that they will pay for themselves by reason of their earlier fruitfulness, long in advance of the root-grafted trees. The latter send out more or less roots above the insertion of the graft, and consequently there is no hinderance to a free return of sap from branch to root. But, in the tree worked above ground, the point of union between the graft or bud and the stock has a cicatrix, with a tortuous and irregular arrangement of vessels, which acts on the principle of a ligature, in hindering the free return of sap from the branches. The consequence is an earlier and greater development of fruit spurs. This fact is still

more clearly demonstrated by working the pear on quince stocks. The union is reluctant, the cicatrix frequently assuming the appearance of an unsightly knot, with a very tortuous arrangement of vessels, and the consequences are early fruitfulness and often increased size of the fruit.

PEACHES.

The peach, with us, is a short-lived tree. Owing to the worm at the root, and the severity of the past winter, we have but few trees left in this vicinity. The fruit is often destroyed in the bud by the severe blasts of winter. Budded trees are more tender in this respect than seedlings. Something is due to difference in varieties, but there is more due to the budding. In the budded trees, the sap does not find its way from branch to root so readily as in the seedling, and the consequence is, that the fruit-bud on the former has a larger growth, is not so compactly done up, and therefore cannot so well resist the action of frost. This difficulty might, perhaps, be obviated, to some extent, by propagating by layers. Should any one be skeptical with regard to the soundness of my position, as to the effects of the cicatrix, let him dissect carefully a few young trees at the point where the bud or graft is inserted.

PLUMS.

The plum is not worth planting here to any extent on account of the curculio.

CHERRIES.

Cherry-trees of the Heart family cannot abide our winters long. They are not worth planting. The Morello and Duke cherries are hardier, and sometimes bring remunerating crops.

RASPBERRIES.

The Native Black Raspberry, (*Rubus occidentalis*,) does better here than any other variety.

Strawberries.

Strawberries do well on our soil when properly cared for. The people in the country will never be well supplied with this fruit, so long as they have to keep up the distinction in the beds between staminate and pistillate plants. The former soon overrun the latter, and the beds become unfruitful. I have tried many varieties, with good success, but can better afford to cultivate, for family use, a plant which I have under the name of Keen's Staminate, than any other. It is a strong grower, and can sustain itself better against weeds, grass, and drought than any other variety. It has both stamens and pistils sufficiently perfect to insure a fair crop of large, fine-flavored fruit. I have not tried Longworth's Prolific, but suppose, from what I read of it, that it will prove valuable.

I will call the attention of the public to a cheap and expeditious mode of destroying caterpillars, invented by myself: Take a piece of machine card, such as wool-carders use, and wrap it round the end of an old broom-stick, and nail fast with tacks. Lash this to the end of a pole of the requisite length, made of any light wood. Go through the orchard early in the morning, before the worms have left their nests, and by thrusting the card-covered end of your pole into the nest, and giving it a few turns in the right direction, you will bring down the entire nest, with all its contents, handsomely wrapped up in it.

I will close, by saying that I have received but two letters from fruit-growers in our State, in answer to inquiries. One from Mr. John W. Tinbrook, of Rockville, Park county, which I condense and herewith submit; the other from Mr. Reuben Ragan, of Nicholson, Putnam county, which I beg leave to submit entire.

Mr. Tinbrook writes substantially as follows:—

Apples.

The soil is a dry loam, with very little sand, based on a yellowish clay, to the depth of 10 or 15 feet; under that, blue clay. The out-cropping stone in bluffs and beds of streams in the neighborhood is sandstone, at from 50 to 100 feet below the general surface. Appearance of country, rolling, original growth of timber, sugar-maple, beech, white and black walnut, poplar, oak, &c. He thinks it improper to manure trees on the rich soils of the West, except to apply leached ashes to such as are subject to spot, as is the case with Newtown Pippin, McAfee's Nonsuch, and some others. The effects of the past winter have been severe in the western part of the State. It is estimated, he says, that one-third of the apple-trees, in timbered land, and two-thirds in prairies, are killed or damaged past recov-

ery. His young pear-orchards all killed to the snow line, except two trees, White Doyenné, and Knight's Monarch. He has cultivated one hundred and forty varieties of the apple, and speaks more or less favorably of the following: Early Harvest, Red Astrachan, Red Juneating, Blush June, Early Pennock, Sine Qua Non, Early Joe, Williams' Favorite, Golden Sweeting, Rambo, Fall Pippin, Fall Wine, Golden Russet, Baldwin, Milan, Rawle's Janet, Yellow Bellefleur, Northern Spy, Michael Henry Pippin, Winesap, Belmont, Hoops, Chronicle, Esopus Spitzenberg, and Newark Pippin. His Baldwin trees are nearly all winter-killed. Golden Russet and Rambo trees very tender, also Rawle's Janet, and Belmont. Winesap is represented as very hardy, and keeps long.

Plums and Cherries.

Mr. Tinbrook considers plums and Heart cherries unworthy of cultivation; the first, on account of the curculio; the latter, because they are winter-killed.

Grapes.

Grapes, carefully pruned, and planted where their roots had access to water, have done well with me, and scarcely showed the rot, while those planted in good dry borders from the same stock and varieties have all rotted.

Raspberries and Strawberries.

Native raspberries do better than others. The following varieties of strawberries do well: Burr's New Pine, Hovey, McAvoy, and Longworth's Prolific.

Peaches.

Park county is represented as a good region for the peach, and seedlings are hardier and surer bearers than budded trees.

Trees are recommended to be trained with low heads, and root-grafting is preferred to stock-grafting or budding, but no reasons given for the preference.

Mr. Ragan says: "The ground on which my orchard stands was originally timbered with large sugar-maples, beech, walnut, poplar, &c.

The soil is brown, with a clayey subsoil, based on grey limestone at the depth of from 4 to 10 feet from the surface; it is upland and slightly undulating.

My first trees were set in the spring of 1828, and others in succession for several years, till now my apple-orchard covers 6 acres, set out at 33 feet apart, which I find on my ground is much too close for large growing varieties. I would much prefer 40 feet.

Apples.

My orchard is composed of many varieties—some not worthy of description, and others very fine. The Rawle's Janet is the most profitable; tree, half-hardy; fruit, when carefully picked and kept in a cool cellar, keeps over till mid-summer. Newtown Pippin, very salable; keeps well till spring; trees, hardy and prolific; fruit, a little subject to bitter rot; Rhode Island Greening, tender in the nursery, but thrifty and very fruitful in the orchard; tree, large and branching, bearing large crops of salable fruit; ripe, mid-winter.

Baldwin—tree, tender in the nursery, and the last winter has proved it to be so in the orchard; out of ten trees which I had in my orchard, nine are dead, and the other badly damaged; and wherever I see it in orchards it is killed. I regret that such is the fate of the Baldwin, for it is a great bearer, a fine, showy fruit, and one of our best mid-winter apples; fruit, highly-flavored, and clear of bitter rot.

Golden Russet—our best apple and tenderest tree; killed last winter; *best.*

Yellow Belle-fleur—hardy; thrifty; most showy of all; fruitful and salable.

White Belle-fleur—half-hardy; thrifty and fruitful.

Pryor's Red—tender in the nursery, but thrifty in the orchard; slow coming into bearing; then hardy and a good bearer; fruit, always clear of bitter rot; fine, and keeping well through the winter.

Esopus Spitzenberg—half-hardy; moderate bearer; *best,* for mid-winter.

Michael Henry Pippin—(in many places called White Winter Pearmain,) half-hardy; fruitful; early winter; *best.*

Pennock—hardy and fruitful.

Holland Pippin—half-hardy; good bearer; *very good.*

Rambo—half-hardy; fruitful; *best.*

McAfee's Nonsuch—hardy; fruitful; mid-winter; *good.*

Oceola—hardy; thrifty; mid-winter; *good.*

President—hardy; thrifty; fruitful and salable, but a little coarse; mid-winter; *good.*

Danvers Winter Sweet—hardy; slow in bearing; falls from the tree before ripe; therefore not worthy of cultivation.

Winesap—hardy; fruitful; *good* all winter.

Vanderveer Pippin—hardy; rapid grower; bearing light crops every year; fruit, large and showy, but coarse; mid-winter.

Gravenstein—a tender tree, slow coming into bearing; killed everywhere last winter; not worthy of cultivation; sometimes erroneously called "Hagloe Crab."

Farley's Red—hardy; thrifty and fruitful; fruit, medium-sized, red, crisp and juicy; all winter; *good.*

Lewis.—This is from the seed of the Pryor's Red; tree, hardy and fruitful; early in bearing; early winter; *very good.*

Fall Wine—hardy; early in bearing; *best.*

Roman Beauty—hardy and very fruitful; mid-winter; *good.*

Northern Spy—tree, thrifty and hardy; slow coming into bearing; apples, large and showy, incline to fall from the tree before ripe; quality, *best.*

Belle-fleur Pippin—tree, hardy, but sprawling in the nursery; a good bearer; fruit, yellow, above medium size; juicy, tender and high-flavored; ripe November; *very good.*

Newtown Spitzenberg—half-hardy; fruitful; mid-winter; *very good.*

Ragan's Red—from seed of Rawle's Janet; hardy; thrifty and fruitful; November; *good.*

Roxbury Russet—tree lacks wood; buds look old and unthrifty; but the fruit is large, sound, and keeps well till late in the spring; bears every other year; *good.*

Chronicle—hardy; thrifty and fruitful; fruit, above medium, greenish ground with red stripes; very firm, and keeps till the next summer with but little care; *good.*

Big Red—hardy; thrifty and very fruitful; mid-winter; *good.*

Cannon Pearmain—half-hardy; great bearer, keeps all winter; *good.*

Transport—tree, hardy; sprawling and very fruitful; yellow, late winter; *good.*

Fall Queen—hardy; very fruitful; red, large, tender, juicy and fine; October to March; *good.*

Monstrous Pippin—hardy; slow coming into bearing; good bearer; very large; mid-winter; *good.*

Hannah Apple—hardy; very fruitful at an early age; red, large; winter; *very good.*

Priestly—hardy; upright, fine bearer; large, red; late winter; *good.*

Prince's Harvest—half-hardy; slow grower; will not do in grass, but needs annual cultivation; the best of early apples; ripe in July; *good.*

Yellow Juneating—hardy; fruitful; ripe in June.

Red Juneating—hardy; slow in bearing; small; August; *good.*

Carolina June—hardy; early in bearing, fruitful; small to medium, oval, striped, tender and juicy; best early apple; July; *good.*

Caroline Red June—also called "Blush June;" hardy; fruitful; small to medium, oval; crimson-red when ripe; tender and juicy, but lacks richness; the trees cannot be distinguished from the foregoing variety.

Early Red—hardy; thrifty and a constant bearer; medium size, red, with a white bloom, flattened at the base, nearly sweet, firm, and rather dry; July.

Summer Queen—half-hardy; good grower; moderate bearer; fruit, from medium to large; highly-flavored; August; *best.*

Red Astrachan—hardy; thrifty and fruitful; tender and juicy, but rather tart; falls before well ripened; *good.*

Sine Qua Non—hardy and fruitful; *best.*

Yellow Hoss—hardy and fruitful; large and very salable; August; *good.*

Hoops—hardy; thrifty; fruitful; medium; flatted; inclined, nearly sweet; late winter; *good.*

Summer Pearmain—hardy; slow grower; moderate bearer; August; *best.*

Sweet Meat—hardy and thrifty; a new seedling from Pryor's Red; seed, medium to large; russetted, tender, juicy and very sweet; ripe from January to March; *best.*

Sweet Bough and *Milan*—tender trees.

Newtown Pippin—hardy; most salable.

Rawle's Janet—half-hardy; profitable.

Pears.

I have tried eighty-eight varieties of pears—some of the best. All have blighted more or less. The Seckel, White Doyenné, and Bartlett are worth all others. I do not think the pear does well on a rich, loamy soil. I think it would have a greater longevity on a mulatto or white-oak ridge land where it would be stinted for nourishment.

The blight in pear-trees, like the cholera in the human system, will ever remain a mystery to some extent. No one can anticipate its approach with certainty, but from long observation I have been led to believe that the cause of blight is vitiated sap, or, in other words, that the descent of the autumnal flow of sap is intercepted by a sudden freeze, which closes the bark, and binds it firmly to the wood, the ropy parts becoming rigidly fixed. In this condition, the roots, which are yet sensible of the cold, continue to send up through the alburnum a copious supply of sap, which is received by the leaves, and thrown back under the bark of the tender twigs and succulent branches, the bark of which, from the warmth of the atmosphere, is made to yield to its downward flow; but not so with the rigid bark at the forks and crotches of the limbs; here, the current of sap is arrested, becomes embedded, and remains through the winter, freezing and thawing, till by next spring it is converted into a perfect pear virus. Many of these deposits become dry through the winter, and act only as a girdle, causing the limb to be larger above, and its fruit much larger than the fruit on its neighboring limbs, while other deposits remain viscid or sticky, and lay dormant till long after the sap begins to flow in the spring, during which time, the sap passes up through the white wood and feeds the buds, the growth starts, and all looks well for an indefinite time, (some earlier and some later,) till at length, the virus sinks through the outer surface of the white wood, and is taken up by the ascending sap, and is thrown into the tender buds and leaves. It is now, perhaps, mid-summer, and the gardener applies his knife below the visible sign of blight; he shortens back till he thinks all looks well, but in a short time it is resumed on the same stub limb. In the mean time, perhaps, there has been a thunder-storm and some hot sun, and he charges it to them; but the blight goes on; he cuts again, and finds the seat of the disease far below, where he had not expected to find it—at the junction of some forks, or at the insertion of the inoculation, where the bark had been closed down the previous fall before the autumnal flow of sap was completely at rest. By the time the seat of disease is found, it is very rare that a case is arrested, and a tree reclaimed.

Cherries.

The *Heart Cherry*—does not do well here. We have none which live more than 15 years. Their bodies are subjected to winter-killing on the southwest side, and last winter has killed all varieties of the Heart, except the Governor Wood. I had three of that variety remain unhurt.

The *May Duke* and *May Cherry*—are worth all other varieties put together, especially for those who cannot bear disappointment; the May cherry is hardy, and a great bearer, and the May Duke, moderate.

Peaches.

Native peaches have done well here, bearing well every 2 or 3 years, and the trees living to the age of 25 or 30 years; nothing appeared to hurt them but breaking with their immense loads of fruit, till the last winter, which killed all in this part of the country. The cultivated varieties, as far as I have tried them, are subject to being killed in the bud, and we but seldom have full crops, though they are much finer than any of our native sorts.

Quinces

The quince-tree does well here on the north side of a fence, where the shade keeps the ground moist and cool; in the sun, it dies in a few years. Last winter killed all.

The cold of last winter, 29° below zero; but on the 21st of January., 1852, 24° below zero, did not kill our peach-trees nor quince-trees, but killed the Heart Cherry trees, on the south and west sides.

Gooseberries.

The *Ne Plus Ultra*—does well, if renewed every third year from suckers, and well mulched in the spring.

Grapes.

Cultivated grape-vines are all winter-killed to the ground in these parts. I had Isabella, Catawba, and Bland; all are killed; the like has not been in the last 33 years.

REPORT FROM ILLINOIS.

BY SAMUEL JACOB WALLACE, NEAR CARTHAGE.

Last summer, we had no fruit in this immediate vicinity, owing to the frost, the 8th of May, which froze most of the garden vegetables, sweet potato plants, of which I had a fine lot, and all the young fruit and blossoms, though there was a better promise of fruit than common. There was fruit both north of here, at Nauvoo, and at Pontoosac, and northeast in McDonough county, and south of here, at St. Albans township, and south and southwest of there. Last fall was warm into November, and trees did not ripen very well, and the very severe winter injured them much; some bursting, and most, or nearly all, being discolored in the wood and more or less injured. This last spring being backward and dry, many orchards looked very bad; and young trees set out did not do well generally Peach-trees were killed to the ground, with a few sickly-looking branches. Wild raspberries and blackberries not bearing this year but apples, Morello cherries, wild grapes, plums, crab-apples, cherries, black-haws, gooseberries, strawberries, and wild fruit, generally, bore well, and the wheat-crop was very good. Fruit is not so fine as usual, rather small, and ripened early, owing to the coolness of the month of August.

APPLES.

The *Early Harvest*—is generally accused of being a poor bearer by Western fruit-growers. Both this year and three years ago, (1854,) when other apples bore, it produced very well; this year, rather small.

Red June—good bearer.

Spice Sweet, Rhode Island Greening, Vanderveer, Virginia Crab, Winesap, Juneating (not heavy,) Rambo, White and Yellow Bellefleur, Maiden's Blush, bearing well.

One of my neighbors recommends the Limbertwig very strongly. He says he knows 6 trees, about 5 miles from here, which have not missed bearing for 8 or 9 years; and that a few years ago he rented the farm, and made from the 6 trees half enough to pay the rent of the whole farm, at $1 a bushel—over $120—and the best late spring apple he knows. Hardy; productive; fruit, easy kept.

Grapes.

I learn that there is a good crop of grapes raised this year at Nauvoo, in this county, where there are several acres in vineyards.

Plums.

Wild plums were very good this year. Out of a great number of varieties I picked some ten or fifteen of the best, ripening for seven weeks in succession, and intend to propagate from seed and grafting from the original trees, as I think many of them will prove valuable.

Pruning.—I think the best way to prune, by all means, is when the tree is growing, pinching in, bending down, tying up, &c.; for, as I think, the pores run through the whole length of the wood, and when the ends or parts of them are cut off, then the whole length of it is almost useless, the sap can pass up to nowhere, and the new branches are connected with the new wood; while that cut off in pruning is, perhaps, in a decaying state, and of course the tree is not so vigorous and long-lived as if it had all the wood, each fibre being connected with a growing portion of leaves. Trees, generally, when growing in the forest, lose all the branches they have when small; when they get old, they have their inner portions more or less in a state of decay, which I should expect to be the case in all trees heavily pruned up, especially in the case of large ones transplanted, having the roots cut, leaving but a thin shell of wood of any value in vegetation. In case large trees are wanted, and the vigor, vitality, and value are of no importance, then they may be transplanted with impunity.

REPORT FROM IOWA.

DY M. L. COMSTOCK, OF BURLINGTON.

Iowa has made praiseworthy advancement in the cultivation of fruit. Notwithstanding the difficulties which inevitably attend the settlement of a new country, the want of experience respecting both climate and soil, fruits have been produced in such quantities, and of such a size and quality, as to excite the astonishment of fruit-growers from older States. We have, in this State, every variety of soil; the rich alluvion deposited by annual floods; the sandy ridge

furnishing little else than silica; limestone cliffs affording along their sides the richest of all fruit soils; high clayey ridges requiring thorough tilth to subdue their refractory nature; and finally, broad, rolling prairies, with a black, deep, fertile soil, destined to be unsurpassed when experience shall have overcome the difficulties which now well-nigh discourage the orchardist. The apple is the principal fruit yet cultivated, probably, because it is more easily obtained than other fruits, and is not so impatient of moisture in undrained soils.

Apples.

Summer Apples.—The most popular, and which prove perfectly hardy, are Red June, Sweet June, (known as Hightop Sweeting,) and Red Astrachan; Early Harvest and Early Bough are popular, but prove rather tender; American Summer Pearmain and Early Joe are fine, but have not been extensively cultivated. The varieties most cultivated for fall use are, Rambo, Maiden's Blush, Fall Pippin, and Fall Wine. The Rambo, the most popular of all fall apples, was universally injured last winter, in some instances trees over 15 years old being entirely killed. The Cooper, Hawley, Dyer, and Orange are excellent, but not much known.

Winter Apples.—Our standard winter apples are Rawle's Janet, White Winter Pearmain, Yellow Belle-fleur, White Belle-fleur, Golden Russet, Roxbury Russet, Rhode Island Greening, Winesap, and Swaar; of these, the Russet, Rhode Island Greening, and White Belle-fleur are rather tender. The Fameuse, Pomme Grise, Peck's Pleasant, Jonathan, and Red Canada are coming into favor as they become known.

Of apples recommended for general cultivation by the American Pomological Society, at its session in 1854, the following may be noted as having been seriously injured last winter: Baldwin, Fall Pippin, Gravenstein, Hubbardston Nonsuch, Ladies' Sweet, and Rhode Island Greening; of those for particular localities, Esopus Spitzenberg, and Newtown Pippin. The Baldwin and Newtown Pippin are probably unworthy of cultivation here. The Newark Pippin will prove valuable. In general, through this State, no pains are spared to obtain the best varieties, though some are popular which, however, are condemned by the verdict of pomological societies.

Pears.

A great many pears have been planted, but the product has not been large, scarcely remunerative, except upon the dryest clayey and limestone ridges. The blight has been destructive to standard trees,

but the cold of last winter destroyed all upon the prairies, both dwarf and standard. If there is any difference in respect to hardiness, it is probably in favor of the Bartlett and White Doyenné. Upon woodlands the injury was not so great.

Plums.

The plum has been cultivated to some extent, and has borne fine fruit in spite of the curculio; but, except in some well-drained fruit gardens, has now gone the way of the pear.

Peaches.

Fine crops of peaches have been produced about every third year, not oftener, owing to late frosts in the spring, or to the open winters marked by sudden changes. Now, there are no trees over two years old, and, of course, no fruit this year.

Cherries.

The finer cherries have been planted; but as yet, little fruit has been produced, and from present indications all that has been done is a failure; and, unless underdraining, or some other expedient, should remedy the evils of tenderness and early decay, such must be the final result.

Currants, Gooseberries, Raspberries, and Strawberries.

The smaller fruits, such as currants, gooseberries, raspberries, strawberries, &c., are produced in perfection, subject only to the accidents common to them in the older States.

There was not a full crop of fruit last year, owing to frosts on the 8th, 9th, and 10th of May, and there is not much this year, from the effects of last winter. Were it not from such causes of failure, portions of our State would already produce more than enough fruit for home consumption. Yet, the watchword is "onward," and no doubt every difficulty will be overcome, and Iowa take the proudest position assigned to her in the predictions of her most sanguine friends.

FRUITS FOR GENERAL CULTIVATION.

The following named fruits were recommended for general cultivation:—

Apples.

American Summer Pearmain,
Baldwin,
Benoni,
Bullock's Pippin,
Danvers Winter Sweet,
Early Harvest,
Early Strawberry,
Fall Pippin,
Fameuse,
Gravenstein,
Hawley,
Hightop Sweeting,
Hubbardston Nonsuch,
Lady Apple,
Ladies' Sweet,
Large Yellow Bough,
Melon,
Minister,
Porter,
Primate,
Rambo,
Red Astrachan,
Rhode Island Greening,
Roxbury Russet,
Summer Rose,
Swaar,
Vanderveer,
Williams' Favorite, (except for light soils,)
Wine Apple, or Hayes,
Winesap.

Pears.

Ananas d'Été,
Andrews,
Belle Lucrative, or Fondante d'Automne,
Beurré d'Anjou,
Beurré d'Aremberg,
Beurré Diel,
Beurré Bosc,
Beurré St. Nicholas,
Bloodgood,
Buffum,
Dearborn's Seedling,
Doyenné d'Été,
Doyenné Boussoch,
Flemish Beauty,
Fulton,
Golden Beurré of Bilboa,
Howell,
Lawrence,
Louise Bonne de Jersey,
Madeleine,
Manning's Elizabeth,
Paradis d'Automne,
Rostiezer,
Seckel,
Sheldon,

Tyson,
Urbaniste,
Uvedale's St. Germain, (for baking,)
Vicar of Winkfield,
Williams' Bon Chrétien, or Bartlett,
Winter Nelis.

FOR CULTIVATION ON QUINCE STOCKS.

Pears.

Belle Lucrative,
Beurré d'Amanlis,
Beurré d'Anjou,
Beurré Diel,
Beurré Easter,
Beurré Langelier,
Catillac,
Duchesse d'Angoulême,
Figue d'Alençon,
Glout Morceau,
Long Green, (of Cox,)
Louise Bonne de Jersey,
Napoleon,
Nouveau Poiteau,
Rostiezer,
Soldat Laboureur,
St. Michael Archange,
Urbaniste,
Uvedale's St. Germain, or Belle Angevine, (for baking,)
Vicar of Winkfield,
White Doyenné.

Plums.

Bleecker's Gage,
Coe's Golden Drop,
Green Gage,
Jefferson,
Lawrence Favorite,
Lombard,
Munroe,
Purple Favorite,
Prince's Yellow Gage,
Purple Gage,
Reine Claude de Bavay,
Smith's Orléans,
Washington,
McLaughlin.

Cherries.

Belle d'Orléans,
Belle Magnifique,
Black Eagle,
Black Tartarian,
Coe's Transparent,
Downer's Late,
Early Purple Guigne,
Early Richmond, (for cooking,)
Elton,
Governor Wood,
Graffion, or Bigarreau,
Knight's Early Black,
May Duke,
Reine Hortense.

Apricots.

Breda, Large Early, Moorpark.

Nectarines.

Downton, Early Violet, Elruge.

Peaches.

Bergen's Yellow,
Crawford's Early,
Coolidge's Favorite,
Crawford's Late,
Early York, (serrated,)
George IV.,
Grosse Mignonne,
Morris White,
Early York, large,
Hill's Chili,
Large White Cling,
Madeleine de Courson,
Téton de Venus,
Oldmixon, Free,
Oldmixon, Cling.

Grapes—[under glass.]

Black Hamburg,
Black Frontignan,
Black Prince,
Chasselas de Fontainebleau,
Grizzly Frontignan,
White Frontignan,
White Muscat of Alexandria.

Grapes—[open culture.]

Catawba, Diana, Isabella.

Raspberries.

Fastolff,
Franconia,
French,
Knevett's Giant,
Orange,
Red Antwerp,
Yellow Antwerp.

Strawberries.

Boston Pine. Hovey's Seedling, Large Early Scarlet.

Currants.

Black Naples,
May's Victoria,
Red Dutch,
White Dutch,
White Grape.

Gooseberries.

Crown Bob,
Early Sulphur,
Green Gage,
Green Walnut,
Houghton's Seedling,
Ironmonger,
Laurel,
Red Champagne,
Warrington,
Woodward's White Smith.

Blackberries.

Lawton's New Rochelle, Dorchester.

NEW VARIETIES WHICH PROMISE WELL.

Apples.

Autumn Bough,
Broadwell Apple,
Coggswell,
Caroline June,
Fallenwalder,
Genessee Chief,
Jonathan,
Jeffries,
King of Tompkins county,
Ladies' Sweet,
Monmouth Pippin,
Mother,
Primate,
Smith's Cider,
Smoke House,
Wagner,
Winter Sweet Paradise,
Winthrop Greening, or Lincoln Pippin.

Pears.

Adams,
Alpha,
Beurré d'Albret,
Beurré Clairgeon,
Beurré Giffard,
Beurré Kennes,
Beurré Langelier,
Beurré Nantais,
Beurré Sterckmans,
Beurré Superfin,
Brande s St. Germain,
Brandywine,
Chancellor,
Charles Van Hooghten,
Collins,
Comte de Flandre,
Conseilleur de la Cour,
Comtesse d'Alost,
Delices d'Hardenpont de Belgique,
Delices d'Hardenpont d'Angers,
Doyenné d'Alençon,
Dix,
Doyenné Goubault,
Duchesse d Orléans,
Duchesse de Berri d'Été,
Emile d'Heyst,
Épine Dumas,
Fondante de Cornice,
Fondante de Charneuse,
Fondante de Malines,
Fondante de Noël,
Hosen Schenck,
Jalousie de Fontenay Vendée,
Kingsessing
Kirtland,
Limon,
Lodge, (of Pennsylvania,)
Niles,
Nouveau Poiteau,
Onondaga,
Osband's Summer,
Ott,
Philadelphia,
Pius IX.,
Pratt,
Rousselet d'Esperen,
St. Michael Archange,
Stevens' Genessee,
Striped Madeleine,
Theodore Van Mons,
Van Assche,
Walker,
Zepherine Gregoire.

Peaches.

Téton de Venus,
Gorgas,
Hill's Chili,
Madeleine de Courson,
Susquehannah,

Plums.

Bradshaw,
Duane's Purple,
Fellenberg,
General Hand,
German Prune,
Ives' Washington Seedling,
Munroe,
Pond's Seedling,
Rivers' Favorite,
St. Martin's Quetsche,
White Damson.

Cherries.

American Amber,
Bigarreau Monstreuse de Mezel,
Black Hawk,
Great Bigarreau,
Rockport Bigarreau,
Hovey,
Kirtland's May,
Ohio Beauty,
Walsh's Seedling.

Grapes.

Delaware, Concord, Rebecca

Raspberries.

American Red,
Cope,
Catawissa,
Ohio Everbearing,
Orange,
Thunderer,
Walker.

Strawberries.

Genssee,
Hooker,
Le Baron,
Longworth's Prolific,
McAvoy's Superior,
Scarlet Magnate,
Trollope's Victoria,
Walker's Seedling.

FOR PARTICULAR LOCALITIES.

Apples.

Canada Red,
Esopus Spitzenberg,
Newtown Pippin,
Northern Spy,
Yellow Belle-fleur,

Pears.

Grey Doyenné,
White Doyenné.

PEACHES.

Heath Cling.

PLUMS.

Imperial Gage.

STRAWBERRIES.

Burr's New Pine, Jenney's Seedling.

FOR NORTHERN LOCALITIES.

APPLES.

Ribstone Pippin.

FOR GARDENS.

APPLES.

Garden Royal.

CHERRIES.

Napoleon Bigarreau (for special cultivation.)

GRAPES AND WINE.

THE WINE-CULTURE OF THE UNITED STATES.

BY JOHN A. WARDER, M. D., OF SPRINGFIELD, OHIO.

The subject of wine-culture in the United States is still in its infancy, and we have yet much to learn in regard to it; although we have reached a point from which we may declare that it is not only practicable but profitable.

Character of the Soil.

In selecting a piece of ground for a vineyard, it should be a matter of primary importance to have a suitable and an advantageous position or exposure. Almost every variety of soil has been planted with the grape, in different countries, and with varying success, this being dependent upon the existence of the necessary elements for its proper nourishment and perfect development. Potash being a very important constituent in the products of the vine, its presence is a matter of paramount necessity; and those soils, therefore, that consist chiefly, or to a considerable extent, of the débris of certain primitive and volcanic rocks, which are rich in this material, would at once suggest themselves to the scientific vine-dresser as best adapted to the grape. Indeed, we find the vine successfully cultivated in countries where the soils are formed directly from rocks of this character. Fortunately, this material of absolute necessity to the growth of a large proportion of vegetables, most widely distributed throughout the world, forms a constituent element, in varying proportions, in most soils; and an analysis will always prove satisfactory, as it will inform us of the relative quantities contained in a given specimen, and hence enable us to derive valuable hints as to the importance of applying an additional quantity of this material, or of any other that may be requisite.

In this country, the grape has been planted to some extent in the micaceous schists, the soil of which is supposed to be rich in potash; but the vineyards I have seen in such situations have not been remarkably healthy. The drift formation, which constitutes a large proportion of the soil in the Middle States, and is often largely made up of gravel, among the pebbles of which occur pieces of primitive rocks, especially where it forms the terraces of our larger and smaller valleys of excavation, has been found well adapted

to the culture of the grape, in certain localities, while it has proved wholly unfit for this purpose in other places. The reason of this diversity is not very obvious; but I apprehend, after having made extensive observations, that the want of more uniform success upon the drift soils, with their varied elements, especially as they exist in the second terraces of our streams, will be found to depend upon an excess of sand in some places, and a defect in the drainage in others. The most desirable and most successful soils of the drift, and indeed those better adapted to the production of the grape than any other, are known to be upon the summits of hills, and are comprised of a fine sandy or gravelly loam of some consistence, with a surface soil of considerable depth, sometimes several feet in thickness, and reposing upon a porous subsoil of similar characteristics, and which are throughout of a very different constitution from the subjacent rocks. The next in value are the loamy clays, with abundant vegetable mould, which are found resting upon the blue limestone, and are composed in chief part of the disintegration of the layers of this rock and its associated clays. These especially occur upon the hill-sides, and are the favorite sites with a large proportion of the vine-planters in the valley of the Ohio and its tributaries.

Position.

The selection of a proper site for a vineyard, independently of the soil, is a matter of no little moment; and yet it is one upon which great diversity of opinion prevails. Probably, from early associations of the hanging gardens and terraced vineyards of Europe, and the idea that the fullest exposure to the sun is necessary to the perfect ripening of the grapes, a large majority of our vine-dressers insist upon the selection of a hill-side with a southern or southerly slope. Accident, necessity, and sometimes a laudable spirit of inquiring enterprise, have caused many deviations from this; and there are those who, having tested all exposures, and with similar soil, prefer any other slope to the southern. Some advocate the eastern, and some the western, while others, and with good reason, prefer the gentle northern declivity, upon which they have observed less injury from frost as well as from droughts of summer, and where the partial shade which the vines may furnish one another appears to preserve them, in a degree, from the deleterious influence of sunshine after fogs and showers.

A free and open situation is absolutely necessary, whatever exposure may have been selected. On this account, as well as for other obvious reasons, which will be noted hereafter, I very much prefer the summit of a hill, gently declining in any or in every direction, to either the terrace or the hill-sides. I would rather plant, tend, or own, one acre of grapes upon the crest of a hill than

two acres in any other situation. The reasons for this will be more fully given hereafter, but may be briefly stated here as depending upon the diminished labor and expense in the preparation of the ground; the superiority of the soil sometimes found in such situations, especially on the river hills; the greater facility and smaller expense of cultivation, which is much less than one-half where horse-power may be substituted for hand labor in stirring the soil; and, finally, the inestimable advantage of an open exposure, freely admitting every breeze, and thus less liable to injury from the effects of rains or fogs, in summer, or from the damage often accruing from the thaws of winter, alternating with sudden changes to frost, which are especially likely to occur upon a southern or warm exposure.

Preparation of the Soil.

It will not surprise any good cultivator to learn that very thorough preparation of the land—appropriated to vineyards—is recommended as absolutely essential. In rocky and mountainous countries, where the grape is cultivated, the rocks are sometimes excavated, walls built, and the earth transported from below to fill these cavities, and hence a most thorough stirring of the soil is effected. In situations less abrupt, as on the hill-sides in our own country, stone-walls are erected to support the soil, and level or sloping terraces are formed, upon which the plantation is made. These walls are of greater or less height, and more or less numerous, according to the sharpness of the declivity. They are sometimes many feet high, of solid masonry, and form a terrace of only a few feet in width, which adds so enormously to the expense of preparation, that one vineyard in the neighborhood of Cincinnati is said to have cost $600 per acre. On more gentle declivities, and where stone does not abound, a substitute for masonry is had in the sod-banks, formed of the compact turf of "Kentucky blue-grass," or, more correctly, green-grass, (*Poa viridis,*) which has become a natural and constant product of the soils resulting from the blue limestone, a kind of land which has proved well adapted to the grape, and which, as has been already mentioned, is very generally selected for vineyards. On the hill-sides, the soil is prepared by means of the mattock alone, or aided by the pick where stone occurs. The laborer, standing on the lower side, digs at the bank before him, reversing the soil, and stirring it sometimes to the depth of from one to two feet, but generally not more than 15 inches, though he appears to have a bank of greater depth in front of him; the deeper the better. The stones are thrown together in piles upon the fresh surface behind him, so as to be ready for removal or for walling. In steep places, the walls had better be made at the time of digging; and, indeed, the sod-banks are always made

at this time. In their formation, the spade is also a necessary instrument. The best grass is selected, properly cut in solid masses, and laid up in steep slopes, and in straight or curved lines, nearly horizontally across the face of the hill; against this bank, the earth is thrown as dug, so as to produce a nearly level surface upon the terrace, when finished. This necessarily makes a greater depth of stirred earth on the lower side of the bench, and the upper side is often quite shallow in its tilth, if the workmen have not been narrowly watched.

Trenching the ground with the spade is a much more efficient mode of preparation than can be effected by the mattock; for, where it is properly performed, the surface soil is thrown down to the bottom, and the fat subsoil is brought to the top, from which procedure results not only the thorough culture that is desired, but the black mould is placed below, for the deep roots and the new soil, free from the seeds of weeds, are brought within the reach of the sun and frost and atmospheric influences. It is not necessary to describe the process of trenching, nor to enlarge upon its advantages, as they are generally understood.

Ploughing the ground has been recommended by some, in situations where it is practicable, but, as commonly performed, it does not give a sufficiently deep tilth; and upon the steep hill-sides, it is manifestly impossible. One of the great arguments in favor of the tops of the hills as proper positions for vineyards is the diminished labor and expense in the preparation of the ground, which, with proper teams and implements, may there be stirred to a sufficient depth by these means for all practical purposes. I would not be understood as under-valuing, much less deprecating, the most thorough and the deepest cultivation of the soil as a preparation for the grape, and, indeed, should not object to a tilth of 10 feet in depth were that practicable; but in this age and country, there are limits of refinement and expense in our operations, beyond which it were not wise to traverse. If we find that lands favorably situated, which may be ploughed 18 inches deep, will annually yield better returns than others that have been dug 2 feet deep, no one can hesitate between the two plans of procedure, where the former is practicable. The expense of trenching an acre of clear soil is about $100. The same land may be ploughed nearly as deeply for from $10 to $15; so that the difference in the outlay in this important item is sufficient to admit of a diminished crop, and the extra sum would go toward the thorough drainage of the land—a very great desideratum, which will presently be advocated.

The best method of preparing the ground by teams is, to use the double plough, the action of which is similar to that of trenching; for by it the top soil is thrown down into a deep furrow by the first plough, while the second brings up the lower stratum of earth, and, in some cases, the subsoil itself is thrown on top. In this way, with a sufficient team, 15 or 18 inches may be turned up, and this may be called trench-ploughing. The same team, or another of at least equal force, is then attached to a subsoil plough, which

is made to run as deeply as possible in the bottom of the furrow already opened; by this means, from 8 to 10 inches of the deeper and more compact soil is so broken and stirred as to admit the air and the rains, and of course, the fibrous roots of the vine will follow, without any danger of meeting the line of excessive wetness, if thorough drainage has also been practised where necessary. The best instrument for this kind of deep tillage is a lifting subsoil plough, with a simple share, or sole, made of steel.

Drainage.

The importance of thorough drainage need not now be argued. Its great value has been fully demonstrated, in various soils and for different crops, all of which are benefitted by the process. Even some of those plants which are considered aquatics appear to thrive better when the redundance of wetness is in some measure controlled by drainage. Of all crops, however, none are more impatient of wet than the grape. To it a dry situation is absolutely essential; it cannot "bear a wet foot." Therefore, if the soil be at all retentive, thorough drainage should be practised, with a complete system of under-drains. This is partially effected in terraced vineyards by the walls of stone, often used to support the benches; and these afford an efficient conduit for the water, which may be led by them to central paved cross-drains, running up and down the hill at suitable intervals, to carry off the water without washing away the soil. The walls alone, however, seldom afford sufficient drainage, and the more complete system of tile-drains would be much better.

Very good drains have sometimes been made by opening a trench across the vineyard, at intervals, and where there was some fall, and filling in the trimmings of the vines, coarse brush, or even corn-stalks. These articles do not furnish efficient and permanent drainage, but for a few years, their effects are admirable, and the healthiness of the crop within their influence is remarkable.

Surface drainage has been much more generally attempted in the vineyards, one object being to prevent washing; but its good influence is also now more generally appreciated as a means of affecting the present crop, and more attention is paid to shaping the ground so as to throw off excessive moisture from the roots, in consequence of the observation that the fruit was more free from disease in the dryest seasons, and more subject to attacks whenever, during the summer, the ground was drenched by heavy rains and the vines surrounded by a damp atmosphere.

This surface drainage is attempted by sloping the benches toward the walls, and also by inclining the terraces themselves, in either direction, toward common outlets for the escape of the water. The shape of the ground also may be so arranged in the process of cul-

tivation as to throw the water from the vines. This may be done with the hoe, or still better, with the plough, when that implement is used. Indeed, one argument in favor of arranging the vineyard for the introduction of horse cultivation is the greater facility of performing this very process, since it is effected by simply turning the furrows to or from the rows of plants, according as we desire to retain the moisture or to throw off the rains from the grapes by means of the furrow in the middle. This furrow will afford a sufficient outlet if the plantation be judiciously made with this end in view, making the rows across the field in such a direction that one or both ends shall be lower than the middle.

The preparation of the soil, in narrow, raised beds, with open trenches between them, will also afford free escape for redundant surface water. One of the best plans in rolling or sloping ground that needs not to be benched, is the division of the vineyard into plots or compartments of convenient size by wide road-ways, which are made deepest in the middle and sodded. These grassy gutters carry off the water without washing, and afford pleasant paths and good cart-ways through the vineyard.

Laying Off.

Having thoroughly prepared the soil, the next process will be laying off the ground for planting. This affords an opportunity for the exercise of some skill and taste. The common plan, whether upon the level or on terraces, is to stretch a line upon one side of the piece to be planted, and with a measuring rod to lay off the distances which have been determined, and mark the stations with little stakes. On terraces, the first row is made upon the lower side. In setting the line for the second row great care is observed to preserve a parallelism, and the stakes are set exactly opposite those of the first row, so that the plants shall be in rows both ways. On slopes, as well as on wider terraces, the line should be stretched in nearly a horizontal manner, so that there shall not be much fall toward either end of the rows. The cross rows will therefore run up and down the hill.

A quincunx-form of planting has been highly recommended, and practised to some extent, the object being, with a southern inclination, to have every plant separately exposed to the sun and air, though free circulation, always a desideratum, can be better secured by planting in squares.

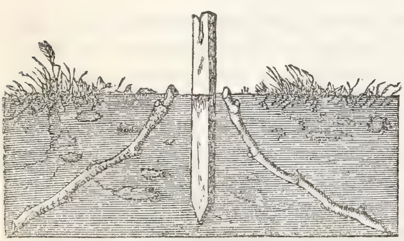
Some planters lay great stress upon the necessity of setting the rows with the points of the compass—north and south, and east and west. Others think, and with good reason, that the points of the compass are of less importance than the points of the land, and that the rows should be made to correspond with the undulations

of the surface upon the hill-tops, and of course with the benches, or terraces, upon the hill-sides, trusting to other arrangements in the planting to secure the full benefits of sunshine and a free circulation of air.

Another, and I conceive a much better mode of laying off, may be pursued in such grounds as have been prepared with the plough. This consists first in observing and staking off a line across the piece of ground in any direction which may be preferred, as a matter of taste, reason, or prejudice, but so arranged with regard to the surface that, while it and its parallels shall be nearly horizontal, there may be a slight fall toward either end—a matter that will appear of greater importance when the subject of surface drainage is considered. The stakes being set, a large plough is run twice in the row, throwing out the soil each way, and leaving a deep furrow in the fresh, mellow earth in which the vines or cuttings are to be planted, while new furrows are formed at equal distances on each side as the planting progresses. To insure straightness, a line may be stretched along the ground, and a steady horse with a light plough used to mark off the furrow to be opened by the heavier team.

Planting.

The old method of planting in poorly-prepared soil, and which is still practised to some extent in Europe, when compensation for a meagre preparation is sought in digging deeper holes for the vines, is not now pursued to any extent in this country. So much has already been said in this essay in favor of thorough cultivation of the soil as a preparation, that it would seem supererogatory to add anything further in this place; and yet we often find that land which has been trenched, or prepared by the mattock, is of such a crude and tenacious clayey consistence, that it appears unfit to receive either the cutting or the virgin vine. This is not often the case with kind soils, especially those which have been well prepared by the plough; and the mode of procedure in planting will hence be somewhat modified.



The usual plan is to dig a hole at each stake, its length being in the direction of the row. These holes are made with a spade, and are usually 8 inches wide by 18 inches long, and a foot deep, for the reception of the young vines (as indicated by the adjoining figure.) When cuttings are used, the hole is made on either side of the little stake, the deepest part being at the

farthest point from it; for two cuttings are generally planted at each station so as to insure a stand. In digging these holes, all crude earth is to be rejected and better soil introduced; in either case, but especially with the cuttings, the part of the hole next to the stake is left nearly full of earth, upon which the top of the plant is to rest. The planter follows, setting one vine in each hole, spreading out the roots in the deepest part, covering them with fine earth gently pressed down, and filling up the hole so as to leave only the crown or wood exposed. If not previously trimmed, the top should now be removed. If the plantation be of cuttings previously prepared, the cultivator inserts two to each stake in such a manner as that their tops shall approximate at the stake. The earth is then pressed about their bases, but only partially filled in, so that the sun may warm the soil about them and accelerate their growth, and so that the rains also may have more immediate access. The upper end, or top eye, however, should be covered lightly with earth, light friable soil being preferred for this purpose. Sometimes, as a matter of economy in labor, the two cuttings are inserted in one hole, which is made rather wide at its deeper part, in which the bases of the cuttings are separated to the greatest extent, so that, if they both grow, one may be removed without disturbing the other.

Planting after the Plough.—When the ground has been prepared by thorough ploughing, and by furrowing out, as before directed, the planting becomes a very simple matter, the excavation made by this implement being nearly sufficient. A little of the loose earth may be thrown out from the open furrow, and the roots or cuttings inserted at the proper points along a line stretched in the row. The loose earth, drawn to them and gently pressed, secures the plant in its place, and the furrow thus retains moisture for the young plant, and tillage gradually throws the earth to them as they grow.

Distance apart and Number to the Acre.—The number of vines must depend in a great degree upon the variety planted. Those of free and luxuriant growth will require more space to develop themselves than such as are of more slender habit. The mode of training which may be adopted will also have its effect in settling this question. With the Catawba, and the system of bow-training, as pursued extensively upon the Ohio, more vines may be crowded upon a given space than could be planted of the Herbemont or other rampant growers, or than would suffice for the same sort if trained upon trellises. The merits of these different methods of training need not here be discussed; either will be adopted as it may prove best adapted to the variety cultivated. The Catawba has been found the most profitable grape in the valley of the Ohio, and its merits are no longer questioned; although other varieties are propagated to some extent, and new sorts are being introduced from year to year, some of which will be noticed in another place. The

remarks in this essay upon vineyard treatment, therefore, will be understood as applying to this variety, unless otherwise specified.

The Germans, not being familiar with the strong growth of our vines, have generally planted too closely; and most vine-dressers continue to do so, though there is a change in this respect, of late years, among those more intelligent. Many vineyards are planted as close as 3 by 4 feet, and others are still planted 4 by 4; but 4 by 5 is becoming more and more common. Four by 6, with ten-foot spaces or roads every four rows, has been found to allow a fuller development of the vine with large crops of grapes. Were the price of the plants a matter of any consequence, the number might be still further diminished, and the vines trained to a greater length on wires or other trellises; but there is a mean which combines the greatest production with the least expense of culture and training. This is, perhaps, about 5 by 6 feet, or not more than 6 by 8 feet, and, at the latter distances, a different method from the "bow-training" would be found necessary. One vineyard, planted at distances of 20 feet each way, having the vines trained to high posts, has been changed into rows of the former distance, with vines 3 or 4 feet apart; these, trained to wires, allow free access of light and air, as well as great facility in the cultivation, by using one-horse power in the wide spaces.

The number of plants necessary to fill an acre will be as follows, but planting two cuttings at each station of course doubles the numbers:—

	Plants.		Plants.
3 feet by 3 feet...........	4,840	5 feet by 6 feet...........	1,452
4 " 3 "	3,630	6 " 8 "	907
4 " 4 "	2 722	20 " 20 "	108
4 " 5 "	2,178	20 " 3 "	726
4 " 6 "	1,815	20 " 4 "	544

Roots, Plants, and Cuttings.

Many persons still prefer to set out virgin vines when planting a vineyard. They think to gain a season by it; but as little fruit can be expected until the fourth year, at which time the cuttings will have come into good bearing condition, there is in reality but little gain. This is in consequence of the check which the plants receive in transplanting. The expense of procuring vines is also at least ten times as great as is called for in obtaining cuttings. It is sometimes, however, a matter of convenience to set the vines; and as they may be allowed to produce some fruit the third year, it is well to plant a portion of a new vineyard with them. For this purpose, strong two-year-old vines are to be preferred, especially if

they have to be transported any considerable distance, as their roots are less liable to suffer from exposure. Older vines are of little value, as they do not so well bear transportation, and are too large and unwieldly. For home use, or for transplanting from one part of a farm or neighborhood to another, where the tender roots need not be long exposed, healthy yearling plants are considered the best.

Cuttings.—These are generally grown from slips made from the wood of the preceding year's growth, which have been trimmed off in the winter or spring. With a pair of nippers or a sharp knife, the sound shoots are cut into lengths of about 18 inches, each having from four to six eyes, or buds, or more when the wood is very closely jointed. The shoot is cut about 2 inches above the farthest bud, and very close below the lowest bud; but many vine-dressers prefer to make the cuttings with a small portion of the two-year-old wood, which they call the "heel," which cuttings command a higher price, as do those also made of close-jointed wood.

The cuttings should be buried in the open ground as soon as prepared, or when received, if transported. They should remain thus till planting time, when the buds will have begun to swell. They should then be taken, a bunch at a time, and, after cutting the lower band, plunged into a deep tub containing a thin mud of clay or soil and cow manure mixed with water. When taken from this mixture, they will be coated with it, and should be handled very carefully, as the swollen buds easily break off. They are then to be set, two to a stake, and bent by pressing the earth down with the foot.

The Nursery.

When these cuttings are planted for the purpose of growing vines for removal or for sale, they are crowded into a small space as a nursery, for which purpose a good piece of rich, mellow, loamy soil is preferred, and if in grass or clover, so much the better. The situation may be low, and rather humid, but should not be wet. If too dry, however, or if the soil be of too stiff a clay, the young plants may suffer from drought. In the spring or autumn, the operator should commence, as for trenching, upon one side of the piece, digging deeply two "spits" with a good spade. When he has opened his trench the whole distance across the piece he intends planting, he stretches a line upon the edge of the freshly-turned earth, and with his spade dresses the bed to the line, the loose dirt falling into the trench and making a good support for the lower part of the cuttings, which are then laid upon the inclined earth, about four inches apart, with their tops against the line, and just so high as to be lightly covered with earth as the digging proceeds. The trenching is then resumed, the top soil or first spit being

thrown upon the bases of the cuttings, and the lower spit upon the top. The next trench having been thus opened, the line is again stretched about 18 or 20 inches from its first position, the earth dressed down, and the next row planted in the same way.

The treatment consists in very carefully breaking, with a garden fork, any crust which may have formed above the vegetating top buds in consequence of dashing rains and clayey soil. This requires great care to avoid injury to the tender shoots, which are easily broken and not always able to push through the clay. A mulching of leaf-mould has been found very serviceable to protect them from the results of baking. After the cuttings have fairly started, they will require very little attention during the summer, beyond an occasional stirring of the soil with a pronged hoe. The weeds must, of course, be removed; but, in trenched ground, they are seldom troublesome. In the fall, winter, or spring, the plants may be taken up, the digging being deep and carefully performed, as the best roots are those which proceed from the lowest joint. If not wanted for immediate use or shipment, they should be covered with loose soil, in some sheltered spot, or stored in a cellar with earth about them. They should also be exposed as little as possible to the wind. When two-year-old plants are wanted, the yearlings may be left another season, or transplanted, if too close.

Layering is another method of propagating vine-plants, and a very favorite plan, on account of the nice roots produced, and because some varieties of the grape may be propagated in this way which will not readily grow from cuttings. For the propagation of plants for removal, the vine-dresser selects such parts of the branches as may suit his purpose when he is going over his vineyard at the season of winter pruning. These are left, instead of being cut off as in the regular trimming; and they must be so situated as to be easily bent down to the ground. After dressing the vineyard in the spring, these branches are either at once pegged down and buried in the soil, with the smaller twigs protruding, or shallow trenches are opened, into which the branch to be layered is simply pegged down, if it be a vigorous "cane" of the last year's growth. As the spring opens, each bud will put forth a shoot, which must be carefully trained upward, and had better be tied to a stake to prevent accidental breaking. As soon as the new wood at the lower joints begins to harden, mellow earth should be gradually drawn up to them, and they will immediately put forth a circle of roots from near their junction with the old shoot, which roots greatly aid their growth and relieve the mother vine. In the autumn, the layered branches may be taken up and divided, when every bud which has forced up a shoot will be found to have become a strong well-rooted plant; so that, in this way, a large increase may be made, and the roots, being in a circle, are well disposed for planting, and may be removed from the soil without injury. Layers should never be allowed to remain attached to the parent vine after the first season, as they are believed to be injurious. It will also be

perceived that this sort of robbery of a plant will materially affect its bearing; so that, where cuttings grow readily, as is remarkably the case with the Catawba, the plan is not generally pursued. With the Herbemont and the Schuylkill or Cape, which are difficult to grow from cuttings, and with new varieties which it is proposed to multiply, this plan is generally adopted. Some persons prefer layered plants to those grown from cuttings, on account of the arrangement of the roots. For home use, they are greatly to be preferred, because they may be brought into bearing much sooner than cuttings planted in the vineyard at the same time, and because a large number may be grown from the old vines.

Culture.—In the nursery, as already stated, nothing is necessary beyond a light dressing of the surface and the destruction of weeds. The new plantation of vines or cuttings requires to be kept perfectly clean, and the tender young vines need careful hand dressing. When they are closely planted, this must be extended over the whole surface, since it is needed to destroy weeds, and may be performed with the common hoe, from time to time, as may be necessary. The Germans prefer to use the heavy-pronged hoe for all vineyard culture, and call this instrument the "Karst." Its prongs are two in number, an inch and a half wide, and 10 or 11 inches long, pointed with steel, and made with a double bevel, or diamond-shaped. This instrument weighs about 6 pounds. Its handle is 3 feet long, and generally so curved that the operator must stoop at his work.

In widely-planted vineyards, the horse-hoe, or cultivator, may be used with great advantage and economy for shallow culture, which is all that is generally needed among the young vines the first season, although the light-turning plough may be required when weeds abound. If used the first season, the furrows should be thrown from the vines, which are too small to bear hilling. Small crops may be grown among the vines this year, if of such a character as will not injure the grapes. Of these, the cabbage is the favorite with the Germans. Some persons plant potatoes, and a partial crop of these esculents does not appear to act injuriously; but some vine-dressers object to the introduction among the vines of any plants lest they might rob the soil of some elements which should be reserved for the grape.

In the second, as in all succeeding years, the culture should be efficient, producing a good tilth, and suppressing weeds. But here we meet with a difference of opinion, some affirming that the soil should not be stirred during the summer, but that a hard surface, of a proper shape for superficial drainage, will be a better condition for the vineyard during the rains of this season. This point was explained under the head of draining. The advocates of this system of hard surface use the Karst, or other tillage instrument, in the autumn, and then deeply stir the soil to receive the benefit of the winter frost and snow, and again give a light dressing in the spring or early summer to restore the desired shape of the surface;

and some even compress the soil with the roller. Here, again, the manifest advantages of horse-culture, applicable in the more widely-planted vineyards, become apparent. With the plough, the spaces may be ridged up in the autumn, and again more readily thrown into the shape necessary for surface drainage in the spring. Generally speaking, the vineyards are dressed early in the spring, after trimming and tying, but before the tender shoots have appeared. A wet soil, however, should never be cultivated. Then, again, after the berries have set, the summer showers are apt to force up such a crop of weeds as to require hoeing or other culture for their destruction; and this often has to be repeated more than once in the season, as a clean vineyard is a necessity, and the contrary has a most slovenly appearance, to say the least. The spring digging comes on at a very busy season of the year, and is of comparatively little use if a thorough stirring has been given in the autumn; hence, some of the shrewd American vine-dressers, with characteristic utilitarianism, have preferred to attend to other important duties in the early spring; and, after corn-planting, when the vine shoots have attained some toughness, they dig or plough the ground, which is then often covered with a good crop of weeds; and they thus save one dressing, and, at the same time, obtain a good application of green manure. Those who can use horse-power have much less trouble and expense, either in the destruction of weeds or in shaping or stirring the soil, and have very little hand-hoeing to do. Indeed, the item of culture in the bill of expenses is reduced 75 per cent. where the horse can be introduced as a laborer in widely-planted vineyards.

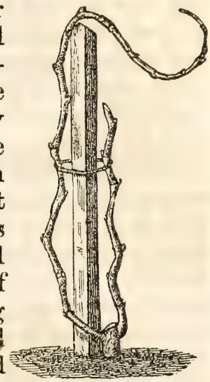
Pruning.—This very important series of operations requires more skill in the performance than any other part of vineyard management. The principles are all exceedingly simple, when understood, and the modifications of their application to practice will depend upon the mode of training which has been and is to be pursued, and also upon the distance between the vines. These will be separately considered, as they apply to the young vine in forming its head or stalk, and, in older vines, regulating the head and branches.

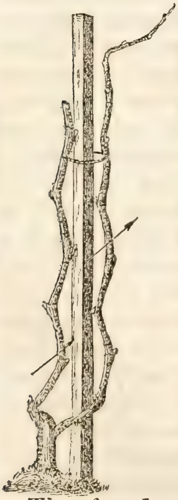
The first principle to be observed is, that pruning has for its object the forming of the plant, and the direction of the flow of sap into a particular channel. It is next to be observed, and borne in mind, that the vine bears best on branches which come from the wood of the previous year's growth, and that wood of a similar character must be produced for the next year's crop.

The cutting, whether in the nursery or vineyard, is allowed free course of growth the *first summer*, and several slender branches are generally produced. There is no doubt that, if the whole growth were forced into one shoot, and if this were carefully trained upward by tying to stakes or trellis, it would be longer and stouter; but, the object being to establish the root, rather than to make wood, at this period, the end is equally attained by the numerous small shoots, with their multitude of leaves, as it would be by a

larger cane. The expense of trimming and training, and the risk of breaking the single shoot, would not be justified by the supposed advantage of stronger wood. Very early in the spring after planting, however, the young vines will need pruning, whether they have been cuttings or virgin vines the previous year; and this must be done with great severity. The object being now to produce only one, or at most two shoots, all the spray is closely cut away, and the main or strongest branch is shortened back to two eyes. This appears to be a total decapitation of the vine; but it is necessary to effect the object we have in view, and to form the head.

The *second year* demands attention to the proper direction of the growth, by means of summer pruning. All shoots but the two strongest should be removed, by rubbing off, soon after the bursting of the buds in the spring, and these must be tied to the permanent stakes, which have now been set in their places, (as indicated in the figure,) all lateral branches, starting out from the "canes," as the strong shoots are called, must be removed, and the weaker of the two canes should be "stopped," or have its end pinched off before mid-summer, so as to direct the flow of sap into the main shoot, and render it as strong as possible. After this, the trimming will depend upon the mode of training, and the "bow" and "stake" system will be here considered.



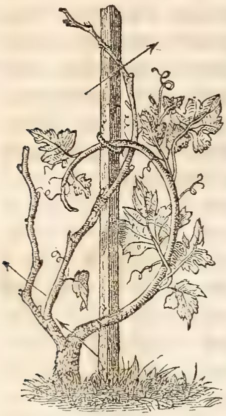


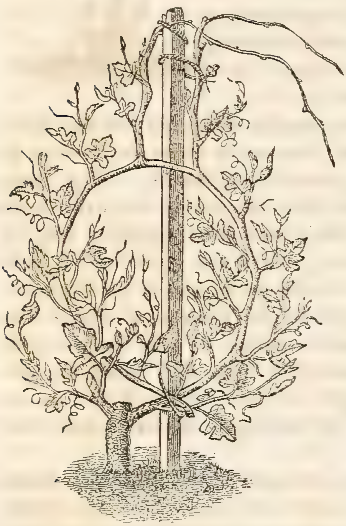
In the *third year*, we begin to trim for the production of fruit, and at the same time take care to make provision for a growth of wood. The cane is cut back, as shown in the figure, to four or more eyes for bearing, according to its strength; but, if it be not decidedly strong, only two eyes are left to form a head, and no fruit is allowed to appear; indeed, it is not likely to be produced from the lowest buds. The smaller shoot is cut to two eyes for producing new wood, or removed entirely, according to the strength of the other cane; as indicated in the cuts by oblique lines across the branches.

The *summer pruning* is conducted upon the same principles as recommended for the previous year. The object being the production of a strong cane, other shoots are to be removed; or, if a little fruit has been allowed to set, the branches must be shortened.

The *fourth* and *succeeding years*, the vine having attained its growth and a sufficient amount of strength to enable it to bear a crop of grapes, the pruning is somewhat modified. We have now to remove old wood, to reserve bearing wood for the crop, and to provide for the production of new canes. The bow with its

branches, which bore fruit the previous season, is to be removed by cutting off close to the cane, as shown by the mark across it in the adjoining figure. The strong shoot for the bow is shortened to six or more eyes, according to strength, and the weaker shoot is cut, as before, to two buds. This is called the "spur," and is the leading feature of this sort of renewal system of pruning. Great judgment is requisite to maintain the head at a proper elevation, and to prevent the stalk from becoming too long, all of which depend upon the judicious management of the spur. In vineyards cultivated by horse-ploughs, the head should be high enough to clear the swingle-trees. Want of care in this particular produces a very unsightly vine, as when the top bud of the bow has been allowed to form a cane, instead of having it start from the spur. The remedy consists in cutting the whole away, back to the spur, and thus losing the crop for one season, or by very close attention to the summer pruning, by which every shoot is subordinated to that from the spur, a neglect of which course the previous year has been the cause of the difficulty, as seen in the annexed cut.





Summer pruning of the bearing vineyard demands constant attention. It may be commenced soon after the buds burst, when the secondary shoots may be rubbed off, leaving but one from each eye on the bow; and this should be that which has the best show of fruit, the bunches being very soon noticed; and so on the spur, but two short shoots should be left. At the period of blossoming, it is advisable not to interfere with the vineyard; but the shoots push with so much rapidity that some of the bearing branches from the bow will very soon take the lead, in wood growth, that should be in the canes from the spur. These should be pinched off at an early period, but not too close to the fruit. Many persons permit but two leaves to remain beyond the outer or upper bunch of grapes, while others prefer to leave four; nor is this any too much, for when we consider the important function of the leaves, and their exposure to injury, we can realize the importance of letting a sufficient number remain on the bearing branches.

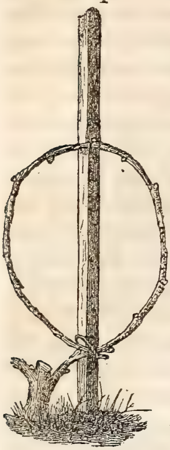
One of the results of this stopping the growth is an attempt by the vine to restore it by the production of laterals, or side-shoots, which, indeed, are always apt to appear on vigorous branches, and are known as "kites." At a later period, these demand attention as a part of the summer pruning. They should be removed from the lower portions of the canes as they appear. This is done either by breaking out, a process which may injure the adjacent bud, or, what is better, by pinching off their tips, so as to leave one or more of the young and healthy leaves, which often come in, very agreeably and usefully, to take the place of the older foliage that may have been injured. The upper portion of the canes should not be disturbed by stopping, or by removing the laterals, unless the excessive growth require thinning. The laterals which occur on the bearing branches should never be rubbed out, but merely pinched in, or stopped. The shade will not injure the fruit, nor prevent its ripening; but the young leaves may be necessary to draw up sap for the fruit.

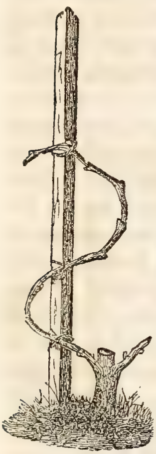
The time for trimming is generally selected with reference to a leisure period, after mid-winter. In the mild, soft days of February, or even of January, this work may be done, when the ground is still deeply frozen, though muddy on the surface; for the branches should not be handled nor cut when they are frosty, any more than when the sap has commenced to flow. Some experiments have been made in autumn pruning, which may be done with safety after the vintage, at the fall of the leaf. No unfavorable results have been observed; and, as it is often desirable to have the cuttings set in the fall or early winter, trimming at this season would be necessary. Before pruning, the ties must all be cut loose, and the vine allowed to fall about as it will, and even to lie upon the ground. This, indeed, is often a means of safety and escape from the injurious effects of cold, as it is well known that many plants suffer less on the ground than in the open air. An ingenious trellis has been invented for letting the vine down in the winter, as well as for inclining it to the sun in summer. The former effect is more cheaply produced, and sufficiently well done, by cutting the ties in autumn.

Training.—Various methods of disposing the branches of the vine have been devised, several of which will be described under their appropriate heads. All the different plans have for their object, in conjunction with trimming, the distribution of the wood and foliage to the best advantage for the fruit and growing canes. That which is most in vogue among our vine-dressers, on account of its simplicity and economy, will be first considered. It is the "stake" and "bow" method modified, according to the taste of the vine-dresser. As already hinted, the pruning and the mode of training must be considered together.

The *bow* method consists of so arranging the shortened cane in tying it to the stake, as to make it assume the form of a bow, or semi-circle, if short, or that of a loop, or circle, if of sufficient length, as shown in the following cuts.

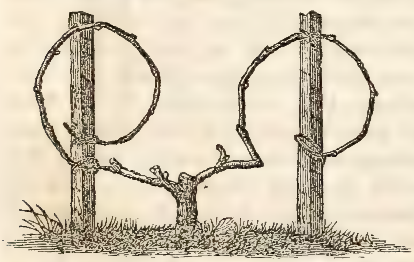
The pruning having been performed for the bow and spur system, as already directed, the training and tying are attended to at a later period. The best time is when the sap begins to flow, but before the buds have started; at which period the canes are less brittle than when dormant. Damp or cloudy weather is then preferable. The lower part of the cane, or the stock itself, is pressed against the stake, and secured by being tied with a pliant osier, or twig of the yellow willow, which should always be grown near a vineyard for this purpose. The cane is then taken in the hand and moderately twisted, and bent to the desired form, allowing the bow to assume the same direction as the row; if short, the end is tied to the stake above, making a semi-circle; if longer, it is brought round to or toward the stock, and there secured; but the upper portion of the arch is also secured by being tied to the stake. Care should be taken to avoid breaking the wood, which should be evenly bent round.





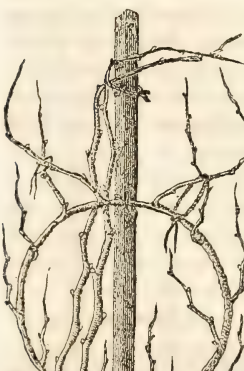
The "double bow" is the plan pursued by some, but not generally recommended in common culture, because of the tendency to over production, which results from retaining too much wood.

The object of this mode of training is two-fold: first, simplicity and economy; secondly, the more equal diffusion of the sap, and consequent growth, among all the buds along the cane. Tying the vine directly to the stake would appear more simple, and would be more suitable, did we propose to make a longitudinal increase of the vine; but we desire to produce the greatest amount of fruit from the bearing wood, which is entirely removed every year, and we provide new wood from another part of the vine, the spur, as already stated. Were the cane tied to the stake in a vertical position, the top bud would receive too large a share of sap, at the expense of the buds below it, and the shoots from them would be starved and meagerly furnished with grapes. It is a well-established law of vegetable physiology, that the top buds always produce the strongest shoots in a healthy plant, while the lower ones are often quite dormant, unless forced into activity by severe shortening-in. Now, in taking the shoot from the upright direction to a curved or horizontal one, the top bud is forced to divide its strength with those below it, and the shoots are more even in their growth and equal in bearing. The bud at the top of the bow becomes the highest, however, and needs constant



watchfulness in the summer pruning, to keep it within proper bounds, and to prevent its forming canes. The principles involved in this plan should be familiar to all intelligent horticulturists, and those who cultivate grapes under glass have recourse to a similar procedure, by letting down their vines, from the rafters to which they are trained, until the buds have fully started all along the vine, and they thus secure an equal distribution of fruit and force.

During the summer, great care should be bestowed upon the proper trimming of the growing wood. As indicated under the head of pruning, we have at this season so to direct the flow of sap as to cause the formation of wood chiefly in the canes, and to repress it in the fruit branches which arise from the bow. This may be done to a certain extent by pinching, but also requires the aid of judicious training. If we bear in mind the tendency of the highest buds to produce strong shoots, and the influence of upright training in causing the same result, the matter becomes very simple. The canes from the spur must be tied up to the stake as fast as they grow, to encourage their growth, and also to protect them from being broken, while the branches from the bow will sometimes need tying to enable them to sustain the weight of fruit, and also to repress their tendency to excessive luxuriance. In the latter case, they must be tied in a horizontal position.



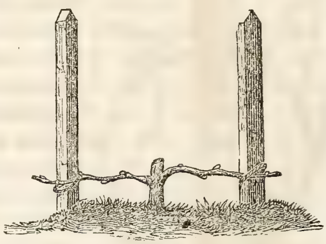
A neglect of these precautions often leads to very bad results; for the shoots from the top of the bow, or the highest buds, wherever they may be, if allowed to be excessive, will subordinate those from the spur which we desire to be the most vigorous, and thus our efforts at the renewal of the vine will be frustrated; for the canes from the spur will not be sufficiently strong to make the bows the next season, nor can we remove the old wood of the former bow, because upon it is the only wood for the next year's crop. At the same time, we are raising the head of the vine from its proper position and are having too long a stem or stalk to the vine, which is the only alternative to losing the crop from such vines for one season, or until vigorous canes can be produced from the spur at a proper elevation from the ground. This is a plan which is often pursued to restore a neglected vineyard, as indicated by the oblique line in the above cut.

The tying may be done with any pliant material that will not injure the vines. In the spring training, willow twigs are used, and make a very neat fastening which will last a long while, and

generally require cutting to loosen the vines from the stakes in the winter, preparatory to pruning. Nothing, indeed, can be better adapted to this purpose. The mode of securing the twigs is exceedingly simple, but must be seen to be understood, as it is almost indescribable. It depends upon the pliancy of the willow and its elasticity combined. One end is held in the left hand, while the other is brought round and twisted about it, and pushed under the band. Some twist the smaller end, and some the larger, and others use the same twist with the willow as with the straw tie in summer tying.

The summer tying requires a softer material, to prevent injury to the young shoots. Dampened rye-straw, about 18 inches long, is generally employed, four or five being used together. In June, the stems of the blue-grass are found to answer very well. When either of these materials is used for securing the vines, the band is passed around the stake or trellis and the shoot, the ends are brought together, the band is then twisted for a few inches of its length, but not the ends, and then suddenly doubled, when the ends spontaneously twist themselves together, and will thus remain without other tying; the projecting ends of the straw, which were not twisted, offering a sufficient resistance to the untwisting of the band. This, although very simple, is not easy to describe, nor, to a novice, is it easy to perform satisfactorily. In all cases of tying, great care should be taken to avoid making the ties too tight, as this would interrupt the flow of sap. Room must be left to allow of growth also; but the extreme of loose tying is to be avoided.

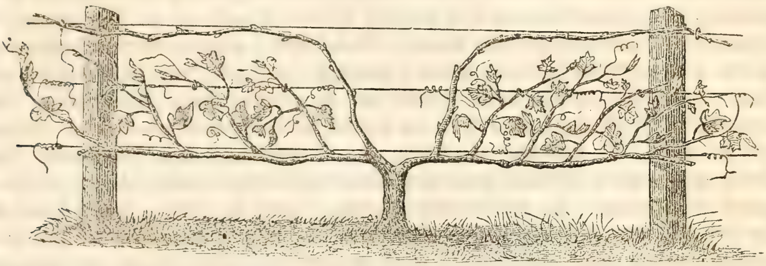
Horizontal training is practised for the sake of effecting the same object, and is so far a modification of the bow system. It is best pursued when trellises of some sort are used, though it may be done with stakes. Wires are the best trellises, and require least care and labor in training either the old or young wood, as fewer ties are necessary, the spring and elasticity of a cane being almost sufficient to keep it in the position desired, and the tendrils of the young growth spontaneously secure the shoots to any position which may be wished. The remarks as to training the young wood, introduced under the previous head, are equally applicable here, and need not be repeated; but the difficulty of regulating the growing canes is somewhat increased.



Several other plans of training may be adopted, among which are trellises and arbors, the "pyramidal," the "spiral," the "distaff," the "tree" methods, and others, to suit the fancy of the individual.

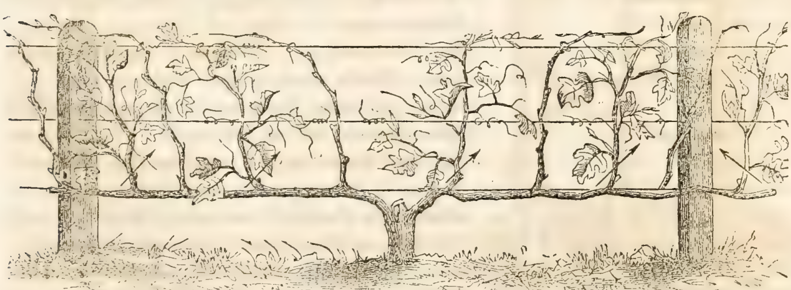
Trellises are made of horizontal bars of wood, or of wires, supported by posts. The training may here be modified according to the proximity of the vines. The length of canes left at pruning-time will depend upon the distances between the plants, and the management will be a modification of the horizontal, as will appear

from the figure, especially if the vines have been widely planted, with a view to this method. The young vines, when they have acquired sufficient strength, say in the second or third year, are allowed to produce but two canes, one of which is led in each direction along the trellis, the side-shoots having been removed and the canes shortened. These are tied to the wires in the spring, and allowed to bear some fruit; at the same time, two new canes only are trained up, from the lower eyes, the renewal system being again



pursued. As the vine grows in strength the pruning will be less severe, but no more canes should be allowed. In the summer training, these are led upward to the top of the trellis, or somewhat inclined, if greater length be wanted. When this is obtained, the shoots are allowed to ramble and produce their laterals.

The *alternate-renewal-trellis plan* is one that may be pursued by the amateur who will take the trouble to watch and train his vine for the sake of exhibiting an immense crop from a single stalk. This method is only adapted to those varieties of the grape which are capable of producing a free growth; to those of a different character it is not applicable. When the vine is well established, two strong canes are produced, which, in the spring, are trained horizontally to the lowest wire and secured to it. Every alternate bud is removed, as otherwise there would be too much crowding on the trellis. Every alternate shoot is also subordinated during the

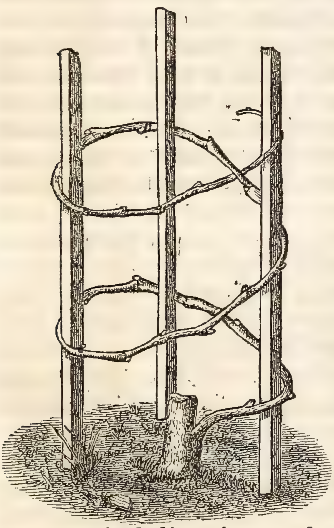


summer, while its fellow is encouraged to become a good cane. The next season, the long canes, being shortened, are trimmed vertically upon the trellis, where they are allowed to bear; their alternates are made spurs, by severe pruning, to one bud, and from each of

these one cane is trained upward during the summer. The next year, those which have borne fruit are reduced to spurs in their turn; and this has hence been called the "alternate cane" and "spur" plan of training. This is better adapted to the amateur and the expert horticulturist than to the common vine-dresser or general culturist. It affords an ample opportunity for the exercise of skill, without which, indeed, it would be apt to result in failure.

Arbors are supports for vines which require very long training of the wood to cover the frame; and the difficulty of trimming is always in proportion to the length of the wood, or to the extent of space to be covered by the vine. The "fan" shape may be adopted, with the several shoots from a young vine, or from a renewed old one, and all may look well for a while, but very soon the lower parts of the arbor will be found to be poorly furnished either with fruit or leaves. Indeed, we sometimes see less and less fruit upon such arbors, and that only upon the ends of the attenuated branches. In trimming them, there is little good wood to be found, especially if an excess of fruit have been allowed the previous years; and the vine is well made the emblem of productiveness, because of its proneness to overbear. In arbor-training, the alternate cane and spur plan last described will be found the most likely to give satisfaction; and the free-growing varieties, or those which bear best on slender wood, should be chosen.

Pyramidal training consists in so branching the vine as to produce a bush of a conical figure, resembling a pyramidal fruit-tree. It is the result of careful trimming, and only adapted to a few varieties.



The *spiral* method is claimed to have the advantage of admitting the air and light within the branches; and this is quite a desideratum, as, where the growth is very luxuriant, there is sometimes a want of circulation among the leaves when all the growth of the vine is tied up to one stake. This ventilation is also one of the advantages claimed for the trellis. To train in this manner, three stakes are set around the vine, or near it on one side, and occupy the points of a triangle. The cane, having been cut as long as the vine will bear, is brought round from stake to stake in a spiral manner, nearly horizontal, and secured from point to point to the stakes with the common ties. The summer growth is similarly secured in a vertical direction to the three stakes instead of to but one, as in the common bow method, and is thus spread or separated to admit the air. Of course, this plan will occupy more space than the

simple bow, and requires wider planting; and is better suited to the amateur than for general application.

The *distaff* is a system of spurs of greater or less length, according to the strength of the different canes. In its results, it is more

like the pyramid, and just the opposite of the spiral, as the wood is crowded in the summer. This is a very pretty system, and requires great judgment in its management, which must be directed to the summer growth, so as to have this growth diffused among the branches, instead of being directed into one or two leading canes, as in the bow method. Some varieties of the grape having a twiggy habit are those best adapted to this plan of treatment, which, indeed, will not be generally adopted, as it is almost impossible to make a common laborer understand the mode of procedure.

In the *tree* method, or *suspension* training, adopted in some parts of Italy, the vines are suspended in festoons from one pollard tree to another; these are called "hautins." In this country, we have no tree-training, except the magnificent festoons of wild vines climbing the high trees in our Western forests, or the occasionally neglected vine, which, having escaped from its arbor or trellis, runs over a neighboring tree. From such a case, we have learned something with regard to the pruning and training of some varieties. Thus the Isabella, which appears to do badly with severe pruning, bears and ripens its fruit well when thus neglected.

Stakes.—Before leaving the subject of training, something should be said with respect to the supports for the vines. Stakes are split from some durable wood, walnut, oak, chestnut, cedar, or, better still, black locust. They are made about 7 feet long, and 2 inches square. These stakes are pointed, and driven into the ground near the vine the second year of the vineyard. A large dibble may be used to make the holes. The stakes will need driving again every spring, when the ground settles, and before the tying is done. They cost from $10 to $20 a thousand, and will last from five to twenty years, according to the kind of timber. At the driving in the spring, they should be replaced if defective.

The *wire trellis* is a kind of support that is growing in favor with vine-dressers. A limited number of posts should be planted along the rows in the spring of the second year; to these, a single wire is attached by means of staples, or by sawing a notch into the edge of the post; or it may be passed through holes bored through the post and secured at each end, where the post is also braced firmly. This first wire may be placed about a foot or 18 inches from the ground; the others may be put up at spaces of about a foot, or they may be omitted until the succeeding year. Some appliances have been invented for stretching the wires; but the simple arrangement of Mr. Charles Carpenter, a very successful vine-dresser of Kelley's Island, in Lake Erie, is perhaps the best. He advises commencing 2 feet outside of the first vine in the row, and setting

posts of any good durable timber 50 feet apart. Those at the ends of the row should be set deeply and firmly. At 20, 40, and 60 inches from the ground, bore half-inch holes, and pass through them good annealed wire, about No. 8 or 9. When you have gone through a row, or as far as the wire will reach, make it fast at an end post by driving into the hole from the outside a pin of hard wood, and leaving out several inches of wire to wind around the pin close to the post. It will never pull through, but it should be drawn tight at the opposite end, and secured in the same way. If at any time intermediate supports are wanted, a stake 3 inches thick should be used, having small notches cut obliquely downward with a hand-saw to receive the wire, which may be fastened with a single nail. This can be built for less than a wooden trellis, and is more durable and convenient; and it may be stated that thorough annealing is a better preventive of rust than paint or ordinary galvanized wire.

At the winter pruning, the shoots may be passed to the right and left of the stalk, at an angle of 30° or 40°, to wires of suitable height for their length; and the vine may be obliquely bent round the wire, and tied at the ends. It then never gets down, even though the ties should break; for the fruit hangs on both sides of the wire. The new shoots should then be trained perpendicularly, and the whole plant thus freely exposed to the sun and air.

Diseases.

Mildew and Rot.—There are many troubles incident to the grapevine and its fruit, but, fortunately, we know little about its diseases in this country, where the inherent vigor and health of our varieties preserve them from serious attacks. The fruit, however, has been affected with mildew in its early stages. This generally occurs during damp weather, when the fruit is quite small. The same atmospheric conditions seem to attend, if they do not cause, the formidable attacks of a similar character, which constitute what is known as the "rot." A great deal of investigation has been made into the causes of this malady, which in a few days often destroys a whole crop, after the berries have attained nearly their full size; but as yet, these researches have been attended with unsatisfactory results. Thorough culture; no culture; hard, clean surface; and even a weedy vineyard; high manuring in Missouri; starvation in Ohio; and various other conditions have been observed as attendants upon immunity from this disease. Hence it appears that we know very little respecting the causes of the malady, and therefore cannot safely prescribe further than to advise the selection of an airy exposure, with an open subsoil for planting, the use of thorough and also surface drainage, ample space among

the vines for free ventilation, and such management of the training and summer pruning as to prevent the crowding of the shoots. To these may be added the use of the wash made by mixing a pound of sulphur with a peck of freshly slaked lime, and 6 gallons of boiling water, well stirred, and then covered up, cold water being added, however, to fill the barrel. The clear liquid is to be applied with a garden engine or syringe, or simply by sprinkling over the vines. Some varieties of the grape, it may be remarked, appear to be more obnoxious to the malady than others, and some have never been seen affected with it.

The *yellow leaf* is often observed in the early part of summer, especially upon young vines and in those planted in very stiff clayey soils; particularly, also, in neglected vineyards, that have not been very well prepared. This gives a bad appearance to the vines, and indicates that something is wrong, but it is not generally considered a matter of much moment.

The *crack* is a dry bursting of the grape, which becomes hard. It is peculiar to some varieties. The "speck," or "scald," appears to result from the sun shining through a drop of water, which, acting as a lens, concentrates the heat. This is only skin deep, and does not otherwise affect the fruit. The "bitter rot" affects the ripe berries, and is supposed to arise from the sting of an insect, and to be, in fact, putrefactive fermentation. Such berries are injurious to the wine, and should always be rejected.

Frosts often produce serious effects upon the vineyard. The intense cold of winter may destroy the vine, to the ground at least, though this is not often the case, and may be avoided to a great extent by cutting the ties in the autumn; or, where practicable, by covering the vines with earth, as they will then be quite safe. In some cases, the buds only are injured, and, as these always have a dormant fellow beside them, capable of being pushed forward and of producing some fruit, there may still be a partial crop. The late spring frosts are those which are most frequently injurious, the young shoots being so tender as to be readily destroyed ; and then it is too late for a reserved bud to come forward effectively. For this, therefore, we can have no remedy, but must quietly submit, and exercise forethought in selecting the site for the next vineyard, and set it upon a hill, with good drainage, as such situations always have less frost than lower grounds.

Insects are often very injurious, and we must expect them to increase on our hands. The first of these which makes its appearance is the "bud-cutter," a small blue beetle of very active habits, which bites off the young bud just as it begins to unfold its rich promise of fruit. The next is the "leaf-beetle," (écrivain,) so called from its eating the upper surface of the leaves irregularly, and making them look as though scribbled over with uncouth characters. This insect is pernicious only to the extent that it affects the healthy function of the leaf. Nearly akin to this is the rose-bug, a most voracious little creature, which, in some parts of the country, has proved very injurious to the vine by devouring the leaves. Its comings are irregu-

lar, sometimes for a few successive years, and then it disappears entirely. The large yellow beetle, with black spots, and a green worm, come later in the season, and often cut off the young shoots and the bunches of grapes. The treatment for all these is to destroy them by waging a war of extermination. A large white grub sometimes cuts off the vine stock just below the surface of the soil, where it works under cover of darkness, wholly unsuspected until the plant is destroyed.

Manuring.

Some persons advise that the soil should be well manured before it is prepared as a vineyard. They recommend the application of lime or gypsum to a crop of clover, which is to be turned under as a green manure. To this no objection can be offered; on the contrary, lime, plaster, bone-dust, and especially potash, which may be furnished in the form of ashes, constitute important elements in the food of the grape, and should be supplied, if not already sufficiently abundant in the soil.

Generally speaking, the land appropriated to vineyards is new or virgin soil, or that which is naturally rich and has not been much used and exhausted. Indeed, the very excess of fertility has been objected to by some, as producing too much wood growth; but there is a mean, and true fertility should be understood as the proper admixture of all the necessary elements to perfect their growth. Such a soil will not be too rich for grapes. Rich, mucky soils, whether natural or artificial, are unsuitable for the grape. In such land, the shoots would be large, open and porous—what a gardener would call "sappy;" and thus, with large cells and open fibres, they would suffer from severe cold, though close-jointed firm wood escapes injury even from the lowest depressions of temperature. Such land as will produce short, firm straw, with close, compact heads of heavy, plump grain, will be best suited to the grape.

In consequence of having observed these effects, some persons select the poorest lands for the vineyard; and there is a difference of opinion among vine-dressers as to the propriety of manuring; but judicious applications of fertilizers may be made with the best results. Whether these should consist of stable-manure, muck or leaf-mould, bones or prepared phosphates, lime, gypsum, guano, ashes, silicate of potash, oil cake or poudrette, &c., must depend upon the wants of the soil relatively to the necessities of the crop to be grown.

Even in our fertile soils near Cincinnati, good effects have been produced by large applications of hog-manure, and other animal ordure, as well as of boiled bones. And notwithstanding the prejudices against the application of these materials, and the assertion that they would deleteriously affect the wine, it happens that this treatment has not prevented the manufacture of a superior article, to which premiums have been awarded.

VARIETIES OF GRAPES.

The list of grapes is becoming so large by the annual additions of new seedlings that all cannot be named here. Such only will be noticed as have been largely planted, or promised well.

The *Catawba* is the grape generally planted in vineyards for the production of wine. It is also a valuable table grape; but its northern range is about the 40th parallel of latitude, except in very favorable situations, such as the immediate southern shore of Lake Erie, or, particularly, Kelley's Island, in that lake. Being a native of North Carolina, it will probably succeed far to the south. Indeed, the recent accounts from South Carolina make it appear that it is there far more productive, and much sooner in bearing, than in a more northern latitude.

The *Isabella* is also very favorably and extensively known. It will ripen further north than the Catawba, and is with some a favorite variety for table use; to wine-making, however, it has not proved itself well adapted, as the must is not sufficiently rich in saccharine matter. As already noted, it does not bear the severe pruning commonly practised in vineyard culture, and the trellis or arbor will be more appropriate for it, as high training suits it better than low.

There are several varieties of Isabella, or seedlings from it, with more or less of the characteristics of the supposed parent, such as the color of the wood and fruit, shape of the foliage, &c. Some of these may prove of even greater value. Among them, the "Shaker" bears the palm for size, rivalling the Black Hamburg in the dimensions of its berries. The juice, however, so far as it has been examined, does not appear to be any richer. The Shaker has also a vigorous growth of wood and foliage; the canes of one year's growth have been seen 20 feet long, and an inch in diameter at the base. With this tendency to exuberant growth, there appears to be a very open cellular structure, and the effects of frost have been very disastrous. As a remedy, or preventive rather, it has been suggested to manage the summer pruning so as to divide the force of the vine among several shoots of moderate size, instead of permitting the growth of such enormous canes.

The *Marion* is another variety, having apparently some consanguinity with the Isabella. It is a healthy vine, a good bearer, perfects its fruit well, and is of fine flavor. None of these, nor any other of the "Isabella seedlings," as they are called, have been sufficiently tested as a wine grape; neither do they promise well.

The *Ives' Seedling* is said also to be from the Isabella; but its habit is much more like the "Fox," in leaf and pubescence at least. The berry is smaller, and the bunch of moderate size; but the vine bears well, and the berries are not affected with rot, when

other varieties all around it are entirely destroyed. On this account, it may prove a valuable acquisition.

Seedlings from the Catawba have been produced without number, some bearing green berries, and one, the "Mammoth Catawba," producing them of very large size; but, as yet, none of them promise to be of any great value.

The *Herbemont* is a very free grower, making canes of 20 and even 30 feet in length, with beautiful and peculiar foliage, its leaves being smooth, resembling the foreign varieties. The bunches are large, compact, and often "shouldered;" the berries small, often compressed, without pulp, acidulous, very palatable, and a wine grape of high character. The habit of this vine requires that the pruning should not be so close as for some other varieties, and hence the trellis is better than the stake. The cellular character of the wood renders it more impatient of cold also, and rather tender. The cuttings do not strike so readily as those of other sorts, and this vine is therefore best propagated by layering.

The *Ohio*, long known as the "Cigar-box," and believed to be the same as the "Jack" grape of Natchez, Mississippi, is also a free grower, adapted to trellises and long training. The bunches are large, and less crowded than the Herbemont; the berries are small, without pulp, acidulous, very agreeable, and promise well for wine.

The *Missouri* is another small, dark grape, but of a brighter blue than the last named. The berries are in loose bunches; they have no pulp, are very sweet, exceedingly attractive to man and birds, and ripen early. The wine from this variety is strong, and has been thought to resemble Madeira. The vine is slender, making very feeble growth, and hence should be planted closely in the vineyard. The distaff method is better adapted to this variety than any other mode of training.

Fox Family.—The "Fox" grapes are characterized by the pubescence of their leaves and young shoots, the leathery appearance on the under side of their leaves, and the small size of the bunches, which are generally loose. The berries are often very large, with a tough skin and exceedingly firm pulp. With these characteristics, we should not expect to find them very valuable for the production of wine. One variety has been cultivated, however, with a view to its usefulness for flavoring other grapes, as it contains the musky character in a high degree, and is softer and in many respects better than most other members of this group. It is called "Minor's Seedling," or the "Venango."

The *Cape*, or *Vevay Grape*, *Alexandria*, *Alexander's*, or *Schuylkill Muscadell*, which the American Wine-Growers' Association have determined to call the "Schuylkill," is still considerably cultivated. It is a moderate grower and good bearer, with dark berries, having a rather firm pulp, and making a red wine of high character, which has been compared to Chambertin. The Swiss settlers at Vevay, Indiana, planted this variety somewhat extensively.

Wine-Making.

Vintage.—The gathering of the grapes should not be commenced too early, an error into which many persons are often tempted. The process of ripening continues, in the more complete softening of the pulp and the formation of saccharine matter, after the coloring of the berries has given the appearance of maturity. Experienced vine-dressers are becoming more careful to avoid hurrying the vintage too early, and find their advantage in the richer product of juice. The vintage is obtained by cutting the ripest bunches with a sharp knife, so as not to bruise nor crush the grapes, which are collected in baskets and transported to the press-house, where they may be spread out upon shelves until a sufficient quantity is obtained for a pressing. Some persons, after allowing their grapes to become perfectly ripe, spread them, when gathered, upon well-ventilated bins or trays, or upon straw, where they may evaporate the excess of water ; and thus the must produced from them will be richer in saccharine matter.

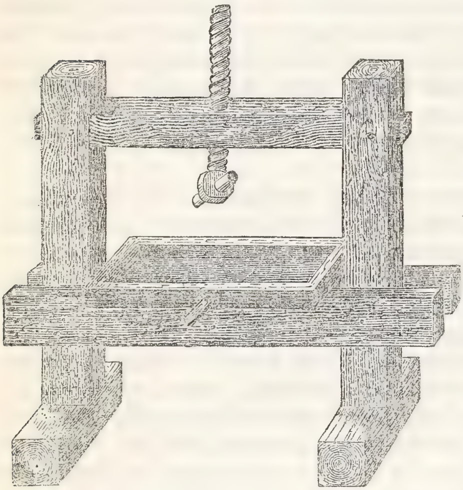
Sorting the grapes is necessary to the production of good wine. If, from want of care in gathering and transporting, any of the berries have been crushed, or even broken from their stems, they should be removed, unless the grapes are to be immediately put upon the press. All green or imperfectly-ripened grapes should also be removed before pressing, and great care should be taken to reject any that have the bitter rot or other form of decay, as this seriously affects the future character of the wine. Some prepare the grapes for the press by stemming them, for which purpose a coarse sieve is used, upon which the bunches are placed and rubbed from side to side with a piece of board, so that the grapes are pushed through and the stems retained. It is supposed however, that the tannin of the stems is of service to the wine.

Mashing the grapes is considered a necessary operation, even where a large press is used. When practised, it may be performed by a beater in a deep tub, or by a mill, consisting of double rollers, which crush the grapes as they are received from a hopper.

"Treading the wine vat" is not practised in this country, though in some parts of Europe it is still pursued. The most perfect cleanliness should be observed in all the processes of wine-making; and with this view the grapes are broken in a machine constructed for the purpose, or sometimes passed through a cider-mill, when the mashed grapes are either at once put upon the press or allowed to lie in the vat for a longer or shorter time, according to

the desire of the vine-dresser to produce a light or a high-colored wine, as the coloring matter, which is in the skin, is most effectively obtained by its maceration in the juice. Sometimes the mashed grapes are even allowed to remain in the vat until they undergo fermentation, which is called "fermenting in the skins." In addition to other properties thus acquired, the wine is rougher as well as more highly colored. The austere wines of France and Spain are prepared in this way, and the process is allowed to go on until the froth and skins rise to the top and crack with the escape of the gases produced by fermentation, when the wine is drawn off from the lower part of the vat.

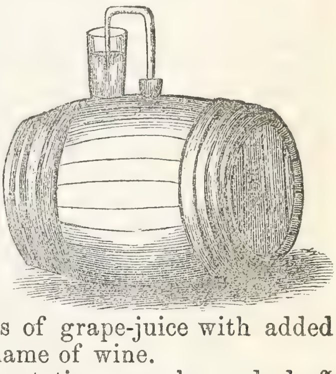
The *press*, from a wooden lever, with a coffee bag full of grapes, as its fulcrum, has grown to be a grand affair, and is quite an expensive piece of apparatus. A perfect iron screw, of 4 inches diameter, is the means of obtaining power. This may be used in a strong frame like that of a cider or hay-press, or, still better, standing alone on the platform of heavy timbers which are firmly bedded together. The screw is surrounded by a collar of tin, to screen it from the action of the grapes that are piled upon the platform, in a framework, with straw, or are retained in place by straw alone, as the cheese is formed of apple-pomace for cider making. The sides of the cheese may be cut down two or three times, and the trimmings thrown on top, upon which the strong pieces of plank and blocks are placed to receive and equalize the action of the screw. Great power may be had with a lever applied to the follower of this screw; and by some simple contrivances, this has been much increased. The pomace is reduced to a dry, flaky mass of skins, stems, and seeds, when the pressure has been well applied; and this is then called the "mare," (cheese,) and may be wet and mixed with the inferior grapes, and again subjected to pressure, to make vinegar; or the mare may be allowed to ferment preparatory to the manufacture of brandy. It is frequently thrown away, however, or returned as manure to the vines.



The *must*, or grape-juice, is conducted from the press by conduits, when the press is over the cellar, and led into the casks for fermentation. The casks should be perfectly clean, and the practice of "stumming," or burning sulphur, is generally pursued. Paper is prepared by being dipped into the melted sulphur, and a small piece of this is burned within the cask for the purpose of fumiga-

tion. The cask may be of any size, from that of a whiskey barrel up to a Heidelberg tun; but a considerable quantity, the result of one pressing, say 300 or 400 gallons, is generally put into one cask. The common estimate is 4 gallons to a bushel of grapes.

Fermentation commences soon after the must has been put into the casks, unless the cellar be very cold; for these casks should always be placed in a deep cellar, so as to keep up an equable and low temperature. Good ventilation should be established, and perfect cleanliness and purity of the wine-cellar are also absolutely necessary. The fermentation depends, however, upon the access of air at a temperature of 50° to 60° F., which, combining with the gluten present in the juice, changes the sugar into alcohol, and in the fermenting process, throws off a large amount of extraneous solid matter, so that the wine is purified and becomes "fine." There escapes, at the same time, a large quantity of carbonic acid gas, the product of fermentation, and this enables us to regulate the force and rapidity of the process, by an arrangement of the bung, which may be loosely put in, or left open entirely; or it may be arranged so as to conduct the process under a graduated pressure by the use of the tube-bung opening under water, which is highly esteemed for this purpose. When used, the casks are not to be filled quite full, as some air must be present. The first fermentation is generally effected in a few days or weeks, and the "wine," as it is then called, gradually settles down to a clear liquid, without any addition. No sugar, nor material of any kind, should be added to the must, to make good wine, as all such additions are considered adulterations; and no mixtures of grape-juice with added sugar and whiskey are worthy of the name of wine.



The wine being cleared by this fermentation, may be racked off into clean casks to separate it from the lees, or settlings, and then may be transported to market for the manufacture of Champagne or of dry wine, as desired; but it is not yet perfect wine, as it still contains the elements of fermentation, and, on the access of warm weather, in the spring, will go through a second fermentation. This is supposed to be owing to the blossoming of the vines; but it is only a coincidence. The temperature at any season is the exciting cause. Until perfectly fermented, the wine should never be bottled, as the expansive force will break the glass. While in cask, the vessel should always be kept bung-full, so as to exclude the access of air; and for this purpose, at the time of racking the wine, reserve casks of small size are filled, from which smaller vessels the larger ones are supplied from time to time.

Racking is not a necessary process. Where the wine may be allowed to stand undisturbed in the cellar, it may remain on its lees. But this process is a good way of separating it from the

deposit; and when the liquid is turbid, so as to require the addition of materials to "fine" it, the racking is done to separate the wine from the substances that have fallen to the bottom in clarifying it.

Fining.—In the process of transferring the liquid from one vessel to another there will be a good deal of exposure to the air, which not only allows the escape of some of its aroma, but also tends to acidulate it; and it is therefore recommended to rack as little as possible. But some wine-coopers advise frequent racking, as, if wine is transported in the first cask, (without racking,) the lees are stirred up, and it grows turbid, and must be allowed time to settle, or requires to be "fined."

Fining wines consists of adding some material that will coagulate in contact with some of the elements of the liquid; and then, as the coagulum subsides, the floating masses that rendered it turbid are carried to the bottom. The whites of eggs, fish glue, and other substances, are used for this purpose.

Bottling consists in transferring the wine from wood to glass; and, as the latter material is brittle, the wine should never be put into the bottles until it has perfectly fermented; for the escape of the gases will either spring the corks or break the bottles, and the wine, in either case, will be lost or damaged. The corks should be of the best quality, and should fit very tight; when cut off close to the glass, they should be sealed with wax. After this, the bottles may be laid upon their sides, and placed either in the cellar or in the garret. The latter position, though a means of ripening and improving the wine, is a severe test.

Analysis.—The means possessed for judging the quality of wines are, first, a fine sense of taste and smell, well practised in testing the particular class of wines. We may decide upon the strength of wine by taking its specific gravity—that is, by weighing it—for which purpose a little instrument is used that shows exactly what per-centage of alcohol is present in a perfected wine. This substance being lighter than water, the mixture will be lighter, just in proportion to the amount present. The alcohometer, used chiefly among the vine-growers, is so arranged as to show also the amount of sugar present in the juice or must, which is an indication of its value or richness. The sugar adds to the weight of water; and must is hence valuable in proportion to the weight it indicates when tried by the wine scale.

Sweet wines may be made to suit certain palates by adding sugar to the must before fermentation, but are considered inferior to good dry wines; and no wine grape, properly ripened and well manufactured, should have any foreign admixture whatever in the preparation of good pure wine, and none other should be made.

GENERAL PRINCIPLES OF WINE-MAKING.

Pure wine, it is well known, is the fermented juice of the grape; and no liquor can properly be called *wine* unless it has undergone a genuine vinous fermentation. The requisite elements for this operation are *water*, *sugar*, *mucilage*, and *tartaric acid* (bi-tartrate of potash.) Besides these, there are certain adventitious elements which may or may not exist in the "must," (pure, unfermented grape-juice,) such as *gum*, or *gluten*, *tannin*, *lime*, *potash*, *carbonic*, *malic* and *acetic acids*, *acetic ether*, *odoriferous matter*, (aroma,) *coloring principles*, *&c.* A perfect *must* should contain a due proportion of the four needful elements. If deficient in any one of these, it must be supplied, or good wine can never be made. If any element is in excess, it must be neutralized or removed.

It may here be remarked that sugar and gluten exist separately in the grape, occupying distinct organs, so that the spontaneous fermentation of this fruit is impossible; and that, as soon as by any solution of continuity they are mixed, fermentation must ensue. The sugar is contained in the cells, which form a skeleton and network of the fruit; but the acid, glutinous pulp does not contain a particle of it. When the grapes are pressed, these two elements are mixed. In the vat, the must is allowed to undergo an active fermentation. By racking, the fermented juice is separated from the gluten, and is then left to a more intimate action called *insensible fermentation*, which is checked at a certain stage by sulphuring. To prevent any renewal of the fermentation, the remaining gluten, which is suspended in the liquid, may be thrown down by clarifying with isinglass or the white of eggs, when it may be drawn off and bottled. The liquid now has the name of *wine*, which is no more nor less than a mixture of variable proportions of water, alcohol, and all the other substances, excepting sugar and gluten, that were contained in the pulp of the grape, such as gum, tartrate of potash, and free tartaric or malic acids.

The more sugar grapes contain, in other words, the riper they are, the more alcohol they yield. Accordingly, the wines of a warm climate are always stronger than those of a cold one. Indeed, it is deemed necessary, in the south of Europe, in order to decompose the excess of sugar which may be present in the grapes, to press them along with their stalks, which furnish to the must an additional quantity of gluten. In the north, an opposite process is resorted to with good effect, and wine of an excellent quality is obtained by the addition of sugar, or even of syrup or molasses, to the must.

The requisite proportion of sugar, or sweet principle, to a gallon of must, is usually about 3 pounds. When it contains less, the

must makes a very dry or weak wine; when more, a very sweet wine. The sugar is changed by fermentation into alcohol, chemically combined in the wine, and is only involved as a vapor by heat, or the process of distillation. In all wines naturally sweet, a portion of the sugar is not decomposed, still more involving and weakening the alcohol. Water added, dilutes the must, and sugar strengthens it.

The specific gravity of wine depends upon its age, the richness and ripeness of the grapes employed in its manufacture, the soil, climate, and aspect in which they grow, and upon the method of conducting the fermentation. It varies from 1.0390 to 1.1283.

The proper proportion of tartaric acid and mucilage in the must does not, perhaps, exceed 5 per cent. each. An excess of this acid renders wine sour. When deficient in this, or is supplied by malic acid, the wine is wanting in body and strength. Malic acid, in excess, changes wine into a species of cider. Many of our native grapes contain too much of this acid, and can never make of themselves other than bad and sharp cider-wines; but, by the addition of a minute portion of quicklime, this acid is absorbed or corrected. If wanting, tartaric acid may be supplied, which constitutes the most important part of the saline matter of wine, and appears to exercise an essential influence over the fermentation.

When mucilage is deficient in the must, no proper fermentation can take place. It may be supplied, however, by dissolved gum, in case of need. An excess of mucilage only produces a greater quantity of "lees." When clear, wine scarcely contains any mucilage, as it is precipitated immediately after fermentation, or by clarification, along with the potash and tartaric acid.

Tannin, the extractive or astringent principle, is communicated to wine by the stems, husks, and seeds of the grapes. Hence, wines are sometimes rough during the first two years, but afterward, the stems contribute to their preservation. Delicate wines should never possess any perceptible astringency or roughness; and the seeds of the grapes used in the manufacture should never be bruised in mashing; nor should the stems, husks, and seeds be allowed to fall into the must. In Portugal, however, the must, husks, and stems are allowed to ferment together in the vats from two to six days. In the meantime, the husks and stems rise to the surface of the liquid, and form a compact mass; the color is still further extracted from the skins; and the stems impart that astringent quality so much admired by all lovers of good Port wine.

The coloring matter of the must chiefly resides in the husk of the grape, and may be extracted by newly-formed alcohol. The natural color of most varieties is purplish or blue; when of a red tint, it is owing to the action of a free acid. The coloring principle, however, is immaterial to wines, as they consist of almost all colors—clear as water, white, yellow, green, hyacinth, red, brown, black, &c., and do not impart any real value to the wine. Some wines lose their color, or change by age; and others can be made colorless, or clear as water, by infiltration through animal charcoal, and may be colored

afterward to any shade of yellow by burnt sugar, or almost any shade of red by cochineal or Brazil wood.

The aromatic and odoriferous matter, or peculiar taste and smell of wines, also called "flavor" and "bouquet," is produced by a fixed oil, different in almost every kind of grape and wine. For instance, several of our best native grapes give to the wines a peculiar, grateful flavor, similar to raspberries. The fox-grapes, with a musky taste, impart to their wine a muscatel flavor. Our fine-scented vine-blossoms, even when dried, give a rich, grateful flavor and scent to wine.

To preserve the aroma of wines, it is necessary to stop the fermentation before it is complete; and to impart to grapes deficient in it, some peculiar flavored substance, which should be immersed in the must while fermenting.

In order to insure a regular and complete fermentation, it is necessary that the grapes should all be equally mashed or trodden, and that the vat which is to contain them should be filled as speedily as possible, within the period of twenty-four hours at farthest. Fermentation proceeds with great rapidity, so much so that the juice, as it flows from the grapes, will often work and ferment before it arrives at the vat. The best temperature for fermentation is about 65° F. It merely begins at 46° to 50°, and is very slow till it reaches 60°. To effect such a temperature, if necessary, several gallons of the must may be heated nearly to the boiling point, in a kettle, and poured into the vat or cask. The quicker and the more violent the fermentation, commonly, the better will be the wine. Small bubbles first collect on the top, and may be seen gradually issuing from the central parts of the liquor, bringing up the grosser matters, which escape in the form of froth, crust, or scum. As an increase of temperature and bulk of the fermenting mass now takes, place, the must loses its original consistency and saccharine taste, acquiring a deeper color and a vinous flavor, with an alcoholic or aromatic odor, the latter becoming more perceptible as the process advances. At length, these commotions spontaneously abate, and after a few hours' rapid fermentation, the ebullition ceases, the liquid subsides to its former bulk, and the crust and solid particles, which disturbed the transparency of the wine, are precipitated to the bottom of the vat or cask.

Another condition necessary to fermentation is contact of the surface of the must to the external air, without which, indeed, no fermentation can take place. This may be effected under sheds in the open air, in hogsheads or larger casks, with spile-holes, valves, or bung-holes. The larger the casks, the sooner it is completed. Light brisk wines, as Burgundy and Champagne, are allowed to ferment only from six to twenty-four hours; white wines, thirty-six hours; and red wines, from two to five days.

It will be seen that the essential operations in the art of wine-making, to correct a bad must, are to obviate any deficiency in the juice of the grapes by supplying the due proportion of sugar, tartaric acid, mucilage, and water, which may be wanting, as well as

to destroy or absorb the malic acid, avoiding the mixture of tannin, and procuring a grateful aroma. Besides this fundamental knowledge, it includes several operations which can only be learned by practice, such as gathering and stemming the grapes, exposing them to the sun, conveying them to the press, extracting, mending, and fermenting the juice, and stumming, fining, clarifying, and preserving the wine.

The grapes should be gathered in the day-time, when the weather is dry and fair. For good wines, none but the sound clusters are to be used; for *particular* wines, well-ripened grapes should be separated from the stems, and the latter thrown away. The grapes should be carried to the vats, or presses, in baskets, without being crowded or bruised; the thin-skinned varieties requiring peculiar care in handling. Our native grapes, however, have generally a thick skin, and require but little care. If dirty, the grapes should be washed previous to mashing.

Green and unripe grapes make dry, light wines, similar to Champagne, Rhenish, Moselle, Graves, &c. Many of our wild grapes are sour, even when ripe, but with the addition of sugar make red, dry wines. In the act of fermentation of the must, carbonic acid is always evolved, and escapes with some alcohol by evaporation. When restrained by bottling, corking, and wiring down, it produces the brisk and sparkling wines usually known under the name of "Champagne." When fermentation is allowed to take its course, most of the carbonic acid is liberated, and what remains is generally called "still" wine.

There are various ways of expressing the juice of ripe grapes. Trampling them under the naked feet, over the boards of the vats where they are heaped, is the most ancient, and, as yet, the most common mode in the Old World, although they are sometimes mashed by rollers in a trough, or a peculiar press with a circular trough. Juicy grapes are very easily mashed, though hard or tough ones require but little additional pressure. With our fox-grapes, it is better to leave them standing, after bruising or mashing, so as to allow their tough pulps to dissolve before the juice is extracted. In no case are the seeds to be bruised; otherwise, the wine will be rough and harsh. When the seeds, husks, and stems of the grapes fall into the vats, they may be separated by straining.

A deficient must may be mended, as already stated. It is then that sugar, water, brandy, lime, tartar, sweet-scented substances, &c., may be introduced to advantage, before fermentation, so as to incorporate well that which can never be done after it. A very pernicious custom, sometimes practised, consists in adding brandy, both real and factitious, to weak wines after fermentation. Brandy thus added never amalgamates well, but decomposes the wine by a slow process, thus destroying its wholesome properties. Whenever strength is required in wine, the brandy should be put into the must before fermentation, with which it is incorporated and modified, the alcohol contained in it being always so chemically combined as to be harmless.

Sugar is not the leaven of wine, as has erroneously been supposed, but the parent of strength and alcohol, into which it is changed by fermentation. Therefore, adding sugar to the must, if not sufficiently sweet, is equivalent to giving strength to it, and is by far preferable to the addition of brandy, either then or afterward. Any other spirituous liquor added to the must or wine, besides true brandy, spoils it completely. Rum and whiskey, or factitious brandy, above all, impart a disagreeable burning taste. Peach brandy, for instance, often used in making what is called "Skuppernong" wine, also renders it fiery. Sweet wines are the best, because all the sugar they contain has not been converted into alcohol, either by a deficiency of mucilage, or by the fermentation being suspended before ending, which may be done at any time by decanting or separating the liquor from the lees and froth by straining or filtering, clarifying, and stumming (sulphuring.) The addition of brandy, however, has always been considered indispensable in making the richer and finer Port wines which are intended for long keeping; for, from their very nature, they would overwork themselves, and, by exhausting their own strength, would ultimately be destroyed. It is true, the grapes from which the richest of these wines are obtained, when hung up in the sun to dry, become complete masses of saccharine matter, or sugar; but this property is only possessed by those grown in positions most exposed to the sun, and afford that luscious and fruity flavor of which no other wine can boast. It must not be supposed, nevertheless, that, because brandy is added to wine, it there remains; for, in reality, it is lost by evaporation in a very short time, particularly in hot weather; and consequently when the wine is drunk, its strength has in no way increased, but, on the contrary, has been diminished by age. The loss of the volatile portions of these wines by evaporation amounts in some lodges to about 3 per cent. per annum.

No acetous fermentation can take place so long as there is a portion of undecomposed sugar in the wine; whence the necessity of stopping fermentation before it is quite decomposed. Sweet wines never change into vinegar. If sugar be added to light and dry wines, it will prevent the acetous fermentation; but if put into them after it has commenced, it increases it. The acid fermentation of wine, by which it is changed into vinegar, takes place when there is an excess of water in it; that is, when the vinous fermentation has been imperfect in weak wines, or when the leaven predominates over the sugar.

Mucilage, the true leaven of wine, separates by fermentation into the lees, which sink, or into the froth, or yeast, that rises. Whenever it remains in the wine it is liable to ferment again, even when in bottles. Therefore, the whole must be separated by racking and fining. If a second fermentation is needed, it may be produced by adding any wine to lees, and mixing them by rolling the cask. A leaven, useful for all artificial wines, may be prepared by drying the lees and froth.

Whenever tartar (tartrate of potash) is to be added, a crude article is the best, because it contains some mucilage of the grapes. Cream of tartar is not so good, although it may promote the briskness or sparkling of the wine.

Quicklime is the ingredient commonly used to correct the acidity of some grapes; but, if not sparingly employed, it imparts a bad taste to the wine. In Spain, they simply sprinkle the grapes with it, and in some instances only give several coats of quicklime to the vats, to destroy the malic acid in the must. In France, they add a gallon of slaked lime to 100 gallons of must. In some places, ground, baked gypsum, or plaster of Paris, is not only used for this purpose, but to destroy the excess of humidity.

After the wine has attained a sufficient degree of maturity, it should be separated from the lees by "racking" it into a clean cask; and, in order to prevent a renewal of fermentation, it is subjected to the operation of "sulphuring;" that is, impregnating the wine, or the cask, with sulphurous acid, whereby the mucilage is precipitated and the fermentation stopped. The black oxyd of manganese has the same properties. A sulphuring liquor may be made by the action of sulphuric acid on saw-dust, conveying the fumes to the wine, or throwing some of the dust liquid into it. The most usual mode, however, is to fumigate the empty casks, before racking, by burning sulphur matches in them, without the flame touching their sides. Another mode of destroying fermentation in wine or other liquors, or even to prevent it altogether, is the use of sulphite of potash (not the sulphate) diluted in them, a single ounce being sufficient for 600 or 800 gallons.

Fining or clarifying is an operation always necessary before bottling. The most usual articles employed for this purpose are isinglass and the white of eggs, although many other substances are used, such as sand, calcined, ground gypsum, common salt, powdered gum-arabic, starch, rice, milk, charcoal, beech-wood chips, ox-blood, &c. They all act in a similar manner, by precipitating the tartar, acid, and mucilage, whereby turbid wine becomes clear and transparent. But none of these substances produce so good results as milk and the white of eggs. The proportion required depends more or less upon the foulness of the wine, added by degrees. Ox-blood and salt are objectionable, as they impart a bad taste to delicate wines. Isinglass, or fish glue, may destroy the aroma, if not sparingly used.

All wines, after the completion of the first fermentation, should be kept in casks in cool stores, cellars, wells, or, perhaps, natural caves. The best cellars are such as occur under uninhabited dwellings, in the districts most famous for wines, exposed to the north, and sunk sufficiently below the surface to insure an equable temperature, say 50 or 60 feet deep, according to the dryness or dampness of the soil. A cellar should be comparatively dry at the bottom, which should either be covered with good, hard gravel, or be paved or flagged; but a certain constant, yet not excessive humidity, is necessary; for, if too moist, the casks may rot, which

would be likely to cause the wine to be musty; if too dry, the staves would be liable to shrink and the wine leak out. The cellar should also be sufficiently removed from any road or carriage-way, as not to suffer jarring or vibration from the wheels. Should it not be in a climate or a position to maintain a regular temperature, say from 48° to 60° F., arrangements should be made to keep one by applying artificial heat during the colder months, and proper ventilation in summer.

The casks should be set horizontally on a "stilling," or squared joists, 6 or 8 inches above the bottom of the cellar, and supported in their places by wooden wedges. Neither stilling nor casks should touch the wall. If perfectly horizontal, the lees will settle in the lowermost side of the cask, and most, if not all, the limpid wine will run off clear.

The "sweating in," or "fretting in," of wines, is a second slow fermentation the next spring after the vintage. This is the best time to bottle brisk wines, to give flavor to insipid ones by the immersion of odoriferous substances, and to deprive them of their mucilage by fining. If this operation be neglected, the wine may "fret" and become pungent. Delicate and superior wines should be bottled as soon as perfectly clear, and at from six to nine months old, particularly if they are to be transported. Common wines should be kept or sent in barrels or quarter-casks. As long as they remain in the casks, they are slowly improving in their quality. There are some superior wines, however, which will stand the cask for three or four years; but it is only in well-corked bottles that wine acquires the acme of its properties.

The best admixture in wines is made by adding good wine, or the essence of wine, concentrated by freezing, to those of inferior quality. The art of mixing wines and grapes is principally confined to the operations of the vineyard. Time and experience alone will teach the uninitiated the practical details.

D. J. B.

TREATMENT OF THE ZANTE CURRANT VINE.

[Condensed from Davy's Notes and Observations on the Ionian Islands.]

As the Zante currant vine has been introduced into this country and has proved sufficiently hardy to stand the climate of the Southern States, the following observations on its future treatment may be useful to those interested in its extension:—

The currant vine, in the Ionian Islands, is far less generally cultivated than the common grape, being chiefly confined to Zante, Cephalonia, and Ithaca. The attempts to extend its culture to the

other islands have been partial, and attended with doubtful success. This, it is believed, is not owing, as has been asserted, to any unfitness of the soil in other islands, as it is analogous on them all, but rather to some difference of climate, especially about the time of ripening, gathering, and drying the fruit; consisting in greater liability to rain, a heavy fall of which is ruinous to the crop, and which, during the period of the gathering, in the currant islands, is considered as a great calamity. In confirmation of this, it may be remarked, that equally in Zante, Cephalonia, and Ithaca, this vine is planted in varied soils and in different situations—in grey marl and in red clay—in the plains and among the mountains—where nothing is common except the long, dry season. A certain soil and situation, however, is considered most suitable for its culture, especially in the calcareous marls, which are worked with facility, have great depth, are easily penetrated by the roots, and are retentive of moisture; it also thrives well in low situations, where water can readily be introduced for artificial irrigation. The marl of the plain of Zante contains a little sulphate of lime, (gypsum,) the presence of a small proportion of which in the soil is conjectured to be beneficial to the development of this grape.

As abundance of water for irrigation is essential to the perfection of the currant vine, the plantations are surrounded by ditches and dykes or mounds of earth, provided with sluices, by which the admission or exclusion of a requisite quantity of water can be regulated. Before the heavy rains in October or November, the ditches and dykes are put in order. Both the broad hoe and the spade are used for this purpose, but principally the latter. The dykes are often planted with the aloe, which, growing luxuriantly in rows, and attaining a large size, has a stately and striking appearance, and is useful as well as ornamental. The large, strong, prickly leaves of this plant make an excellent hedge. Occasionally manure is used, but is far from a general practice. It is believed to increase the quantity of fruit, but injures its quality. The new soil brought down from the hills by rain is considered the natural and most appropriate manure.

The vines are planted in regular rows, 3 or 4 feet apart. A new plantation is formed, either by striking cuttings or by grafting them upon the common vine. The best roots for propagation are obtained by cutting the parent stem in the spring, just below the surface of the ground; after this operation, the shoots start up vigorously. They are cut off in December, covered with light mould, and may be used for planting in the spring—six or seven years elapsing before they come into bearing. The process of grafting the currant upon the common vine, for some years, has been much in use, since the value of the fruit of the one has exceeded that of the fermented juice of the other, especially in Cephalonia. Moreover, it has this advantage: The grafted vine becomes productive in a much shorter time, being in three or four years in full bearing. The operation of grafting is performed as follows: A pit is dug, exposing the trunk of the common vine from a foot to a foot and a half below the surface, near the bottom of which it is ampu-

tated, and two or three perpendicular incisions are made in the stock with a chisel, in the wood and near the bark, into which the last year's shoots of the currant vine are inserted, of such a length as to leave two or three eyes or buds above the ground. Then some moist marl is applied to the grafted part, which is wrapped in leaves, bound with rushes, and the pit filled with earth. The season for grafting, of course, is in the spring, when the sap is ascending.

The pruning of the currant vine is an operation which requires much judgment, not as regards time, for that is established by custom, but in relation to the quantity of wood to be removed, as well as the quality, and even position, of the branches to be left. This is not completed at once, but at intervals. In December, the vines are cleaned; the dead, weakly, and unpromising branches removed; and only a certain number of the more vigorous shoots of the preceding spring are retained, which are selected on account of their position, and the indications afforded in their buds of their fruit-bearing powers. Toward the end of February the knife is again applied, and the remaining branches are removed, so as to insure active vegetation. Each eye is considered equivalent to a fruit-bearing branch; and no more are left than it is supposed can be amply nourished, three or four being the usual number. The grounds, where there is a command of water, are flooded from the end of October or beginning of November till the end of December, when the sluices are opened, and the excess of water is allowed to flow off. About the time the vines receive their last pruning, the earth is scooped out from around the stems, leaving bare the roots, and piled in small heaps near by, thus favoring the watering of the plants and the warming of the roots, as well as the exposure of the soil to the influence of the air. In April, the ground is deeply stirred around the roots, and the surface levelled about the vine.

The currant vine, which is always supported by stakes, is allowed to grow without check; and as the ends of its branches are not broken like those of the common vine, the luxuriance of its annual shoots, under favorable circumstances, is extraordinary. Great attention is also paid at all seasons, especially in spring, when vegetation is commencing, and the opening buds and young shoots are so tender as to be susceptible of injury. If the bud be broken, the embryo bunch is destroyed. The fruit is often sufficiently ripe for the table in the last week of July, and is then of a purplish hue, but not too luscious, as when thoroughly ripe, being agreeably sub-acid and sweet.

D. J. B.

STRAWBERRIES.

FALL AND WINTER MANAGEMENT.

In the cultivation of a plant, the first thing for one to determine is to make himself acquainted with its structure and habits. When he has ascertained what Nature has designed it to do, and what means she has furnished, then only can he judge correctly of the manner in which it may be treated under its artificial circumstances. Then, too, he may know how far it is practicable to alter its disposition, in order to render it more subservient to his purposes.

In applying so evident a truth to the cultivation of the strawberry, it may be stated that this plant consists of a very short stem, seated just at the surface of the ground, covered with leaves, and throwing out from its lower end long slender woody *perennial* roots, which divide into a multitude of branches. The stem itself has a soft centre, with a woody outside covered with the bark, which bears the leaves. The soft centre is a very large pith; and the strawberry stem is, in fact, not essentially different from the branch of a tree, one year old, with all its joints so contracted as to touch each other. The pith is a great receptacle of organizable matter; it is the source whence the leaves and fruit are fed in the spring and early summer; its starchy and gummy contents may be observed at this time of year by any one who will cut it across and touch it with iodine; the gum will then become brown, the starch violet, and the woody matter will remain of a clear yellow. The roots extend to a considerable distance from the stem, branching in all directions in search of food, and increasing in number as the stem increases in age. Their object is to obtain unorganized food from the soil, especially water, of which we know the strawberry to be greedy. When undisturbed, they live for a long time, and are always ready to answer the demands made upon them by the leaves and fruit.

Such being the true nature of this plant, it is obvious that the roots should be preserved. Digging between the rows in autumn or winter, as is often practised by gardeners, with the belief that the roots are only annual, is a mistaken idea. If it be asked, What advantage is gained by destroying them?—as necessarily happens by digging among them, for they are very long rooted—the only answer is, that the soil near the strawberry plants becomes so hard after a season's gathering that it is unfit for their support. This may be, in some places; but, if so, it would be better to loosen the ground with forks as soon as the crop is gathered, when the destruction of a few roots would be of less consequence than to

break it up and destroy a large proportion of the roots in winter or late in autumn. The disadvantages of disturbing these roots are serious, as they contain organizable matter in considerable quantity. As soon as their growth is renewed in the spring, they extend by the assistance of that substance, which enables them to form their spongelets, and to advance into the earth in search of water, &c., which they immediately convey to the stem, while all the organizable matter in that stem is expended, as Nature intends, in the nourishment of new leaves and fruit. But, if the roots are wholly destroyed, the organizable matter in the stem must be directed downward for the formation of more roots; and, of course, the supply intended for the leaves and fruit is diminished in proportion to the quantity of roots which the stem has to form. The strawberry stem, which is designed to form leaves and fruit, only, cannot have its power diverted to the formation of roots without diminishing the vigor of the leaves and fruit.

In conclusion, it must never be forgotten that plants, like animals, consist of two essentially distinct parts: The one the organized material of their structure, the other the organizable matter out of which additions are to be made to that structure; and that under no circumstances whatever can growth take place, except in the presence of the latter. This law is not only one of the foundations of vegetable physiology, but one of the most important of all facts for the culturist to bear in mind, explaining, as it does, the sources of success or failure in multitudes of the operations in which he is daily engaged.

D. J. B.

PEABODY'S NEW HAUTBOIS STRAWBERRY.

Mr. Charles A. Peabody, of Columbus, Georgia, has originated a new seedling strawberry, (see plate III.,) by crossing the Ross Phœnix with a wild strawberry of Alabama. It is hermaphrodite in its character, producing fruit without the aid of another plant, and is itself an excellent impregnator for pistillate varieties. It is a vigorous grower, and sufficiently hardy to withstand a considerable degree of heat or cold. The plants attain an extraordinary size, sometimes so large that one cannot be covered by a half-bushel measure. The fruit is borne upon tall runners, on stems from 3 to 5 inches long, attached to the calyx by a coral-like neck, without seeds—there being very few seeds in the berry. It is of singular form, somewhat irregular, and frequently measures 7 inches in circumference. The flesh is firm, melting and juicy, having the most exquisite pine flavor, and requiring, when eaten, little or no sugar.

This strawberry is a prolific bearer, opening its blossoms at the South during the mild days of winter, and perfecting its fruit as soon in the spring as the weather will permit. When ripe, the color is a rich dark-crimson.

In addition to its excellent qualities, already mentioned, this variety, through its firmness and lack of acidity, will bear transportation better than any strawberry; a week after picking, and after a journey of 1,200 miles by land and water, it "wilted down only a very little."

D. J. B.

NUTS.

NUT-TREES IN VIRGINIA.

BY H. C. WILLIAMS, OF FALLS CHURCH, FAIRFAX COUNTY.

The *Persian Walnut*, or *Madeira N t*, (Juglans regia,) succeeds well in this part of the State, and deserves more extensive culture than it receives. In this neighborhood there are two varieties in cultivation: one of which is quite large; but the other, the "thin-shelled variety," of less dimensions, famed for the superior flavor of the nut as well as for the better bearing qualities of the tree, is to be preferred.

My method of propagation from the nuts is the same as that recommended in the Patent Office Report for the year 1855. Last spring, I transplanted fifty trees, and shall transplant fifty more as soon as they attain sufficient size.

The *Pecan* (Carya olivæformis) may be cultivated in the same manner as the Persian walnut on a generous soil, and will come into bearing in twelve or fifteen years. In the Capitol Grounds, in Washington city, there is a fine young tree, which has fruited for several years, and the nuts are of equal size to those found in the shops from the Southwest.

In cultivating this as well as the preceding, the terminal or leading branch should be cut off when the tree is 8 feet high, so as to form a round head. For the lawn, it is a quick-growing and highly ornamental tree.

The *Filbert* (Corylus avellana) is also to be found in some gardens in this vicinity. It is adapted to our soil and climate, and should have its cultivation extended.

The *European Chestnut*, (Castanea vesca,) of which a few trees are occasionally found, is too much neglected. It is a very ornamental tree, and may be ingrafted upon our common wild chestnut, which is said to cause its early fructification. This tree should be in all collections of useful ornamental trees.

LIVE FENCES.

THE PYRACANTHA FOR HEDGES.

(*Cratœgus pyracantha.*)

The following facts, connected with the Pyracantha, or evergreen thorn, as a hedge plant, were communicated by the Rev. James Curley, of Georgetown College, in the District of Columbia.

The "College-hedge" has stood twenty-six years, showing as yet no signs of decay. It is highly ornamental, and beautiful, even in winter. The plants have a vigorous growth, fresh and lively in appearance, are very close and thick, quite to the ground, broad and flat at top, and with sides neatly trimmed, form a fence, which, on our great Western prairies, would be invaluable. It makes rapid progress, and would begin to answer the purpose of a fence the fourth or fifth year.

This plant is readily raised from cuttings, but as it sends up shoots while quite young, a hedge may soon be propagated from rooted plants. A single row of cuttings is quite sufficient for all the minor divisions of a farm, yet there should be double rows where a substantial fence is required. For a hedge of one row, it is necessary to form a furrow 6 inches wide, and 8 or 9 inches in depth. The cuttings, which may be about 12 inches long, are placed in a straight row on one side of the ditch, 12 inches apart. For a double hedge, make the furrow 12 inches wide, and place the plants alternately on each side, the above distance apart. The best time to set the plants is early in April. While young and tender, they must be protected from the mid-summer sun in the ordinary manner. In August or September, while the berries are ripening, they must be trimmed, otherwise, the following year, the growth of wood is impeded by a heavy crop of flowers and fruit. The value of the hedge depends much upon the judgment used in trimming it ; for, if the main stalk has not acquired sufficient thickness, and the branches are allowed to become long and spreading, the winter snows will press it down and destroy the fence.

As to the capacity of this plant for enduring cold, it may be remarked that, in 1835, the thermometer one night stood from 15° to 20° below zero, and I remember no remarkable injury done to the hedge, which was then only four years old. In 1836, with a temperature 6° or 7° below zero, some plants, on high ground and badly exposed, were slightly injured, caused in part by loss of earth and shelter from the roots. Taught by this experience, I think the plant will flourish in countries where the cold is severe, if planted on level lands.

The College-hedge is a single row, from 5 to 6 feet high, and from 4 to 5 feet in width, with stems varying from an inch to 3 inches in diameter. The thorns are so sharp and strong that few animals will dare approach it.

It strikes me that, if, about the fourth year from planting, particularly upon smooth prairies, two or three furrow-slices were thrown toward the fence, and the embankment finished with the shovel, so as to give the hedge nourishment and protection from a deep bed of soil, the ditch serving also to keep cattle in abeyance, but little trouble and expense would be required to supply the West with elegant and permanent fences.

IMPLEMENTS AND TOOLS.

ARRANGEMENT OF TOOLS.

BY TOWNSEND SHARPLESS, OF PHILADELPHIA.

Were we properly to consider our convenience and true interests, both in a material and moral point of view, we would soon be led to see the importance of the influences resulting from habits of order. Other things being equal, the careful man is generally the prosperous man. Even children perceive the beauty and advantages of care and neatness, and almost instinctively acquire the practice of them, from the example of the persons with whom they associate. There are those who plead that they have "no turn for such things," and should therefore be excused for neglecting them ; but this is an error, the real difficulty existing in a feeling of which few are wholly conscious, and still fewer frank enough to avow, namely, the desire to avoid the trouble of attending to the details of business, or a culpable self-indulgence, amounting to indolence, from which doubtless proceeds the chief part of our troubles and difficulties.

If one has unnecessarily neglected a duty, or left an article out of place which might as well have been returned at the time ; or done a thing indifferently which ought to have been done well ; or failed to accomplish an object for want of due exertion, is it not because he has given way to this feeling, to get rid of which he must earnestly contend against it, and little by little gain the mastery? Early life is the best time to eradicate it ; but it will yield to proper efforts at all ages. We must learn to love labor, and study to make every kind of business a pleasure. By carefully digesting, and then adopting the most simple and systematic mode of performing every duty, greater precision and success can be readily attained. Whatever we are conscious of doing well, we take pleasure in doing ; and the converse of this is equally true. If, therefore, we learn to do everything well, will not the doing of everything then be a pleasure?

The principles of order and neatness are so simple and plain that it needs but moderate attention to understand them, and but reasonable effort to put them in practice; but that effort must be continued and persevered in until we succeed.

An eminent and successful agriculturist, when asked what made a good farmer, replied: "To mind little things." Providing places for things, and keeping them in their places, is an essential of this philosophy.

Plates XLVII., XLVIII., and XLIX. represent the interior arrangements of the tool-house of the writer, which is 20 feet long by 12 feet wide, and lined with smooth boards. Notwithstanding that there are about two hundred tools or implements upon its walls, the number might be considerably increased by filling up the vacant spaces with smaller articles, as occasion might require. The tools are well secured in their places, and yet may be taken down or put up with ease. They are supported by means of nails, iron hooks of different sizes, (such as are used by plumbers,) stout iron staples, both flat and round, and lighter ones made of wire, with the ends sharpened, and of size proportioned to the weight of the tool.

Plate L. shows the arrangement of a tool-closet for a family, by which it will be seen that any set of tools or implements may be so placed as to present a symmetrical and tasteful appearance.

Previous to affixing the tools to the wall, the size of the space to be occupied should be marked out upon the floor, and the arrangement first made there. Some article should be selected as a starting point or centre, around which the others should be so placed as to produce a symmetrical effect. If not at first satisfactory, change the position of some or all; arrange and rearrange them till they meet approval.

The shape of each article is marked upon the wall with a small stiff brush and ink, and the tools being upon the sides of the building, leaves the floor free for other purposes.

The ink for marking should be a little thickened, and spread upon a slate or other smooth surface to prepare it for use, as the lines should be made dark and distinct. A little chalk rubbed upon the place to be marked will cause it to receive the ink without difficulty.

From their methodical arrangement, and the distinct marking of the shape of each, advantages are derived in the economy of space and security against loss which could not, perhaps, be so well attained by any other mode; and it is doubtless the means of causing things to be kept in their places.

The writer, with whom the idea of marking out these shapes originated, has had the plan in operation in various forms for many years, and always with satisfactory results; and the illustrations are presented to the public in the hope that others may be led to the adoption of the plan.

The farmer need not be informed how important it is for every one to have a work-shop, a place where his tools may be neatly and conveniently arranged and safely kept, and where those in his em-

ploy may occupy their otherwise leisure hours pleasantly and profitably.

In the arrangement of tools, as here recommended, the value of the principle of association is forcibly illustrated ; and perhaps there is no other mode so effectual in impressing the necessity of returning borrowed articles, for borrowers are proverbially neglectful of this duty. If, when a tool is lent, the shape of it is seen distinctly marked in the place from which it is taken, an impression is thus made upon the mind of the borrower, which is increased by a recollection of the fact that it will act as a tell-tale, and will not cease its importunities until its demand for the return of the article is satisfied.

Any one who will adopt the plan, however rude or imperfectmay be his arrangements at first, will find a virtue in it in the preservation of his tools, and in promoting habits of good order beyond his expectations ; and, as every one is an example to others for good or for evil, he may thus render important services to his neighborhood.

In every kind of business there are details often neglected for want of being thought of at the proper time. To remedy this, it is recommended that a slate or pasteboard card, with a pencil and a piece of India-rubber attached, should be hung in the shop, spaced and arranged under the proper head, so as to show what special duties are to be performed, and by whom to be attended to.

If the principal would carry with him a small book, composed simply of two pieces of pasteboard, also spaced and ruled, and in it note each matter out of the common order of business, as it occurred to him, that required attention, and at convenience transfer it to the shop memorandum, to be there ready for suitable occasions, he would find it would insure the prompt performance of many small duties liable to be forgotten, the accumulation of which is often more burdensome to the mind of a business man than those of larger moment.

METEOROLOGY.

METEOROLOGY IN ITS CONNECTION WITH AGRICULTURE.

BY PROF. JOSEPH HENRY, SECRETARY OF THE SMITHSONIAN INSTITUTION.

The system of meteorology jointly prosecuted by the Smithsonian Institution and the Patent Office has been carried on during the past year with increased efficiency, and with the manifestation of a growing interest in the subject, particularly in its connection with agriculture. A large amount of valuable statistics has been collected, and quite an addition has been made to the number of full sets of standard instruments, as well as to the number of voluntary observers. The work of reduction has been continued, and the results for 1854, '55, and '56, are now ready for the press. The temperature tables for one year have been stereotyped ; but the cost of the publication of the material in detail is found to be so expensive, that it must be delayed for a time, unless Congress shall make a special appropriation for the purpose. The value of the material is, however, constantly increasing with every year which is added to the series of observations. Though their importance would be much enhanced could copies of them be placed in the hands of all who may wish to deduce general principles from them, or to apply the deductions to purposes of immediate utility, yet they are of considerable use in their present condition, since they are open to all who, under proper restrictions, desire to consult them. They have been of importance in preparing the series of articles to which the present publication belongs, and in furnishing the materials for the fourth report of Mr. Espy, which was ordered to be printed at the last session of Congress.

In the last Report of the Patent Office, I gave an account of the several systems of meteorology now coöperating in this country to advance the science, and also endeavored to show the importance of this branch of knowledge in its connection with agriculture. I propose in this Report and the subsequent ones to continue the subject, and to present some of the physical laws on which meteorology depends, the general principles at which it has arrived, and their application to the peculiarities of the climate of the United States. An exposition of this kind presented to the farmer, through the Report of the Patent Office, it is thought, will serve to awaken a more lively interest in the subject, will tend to diffuse a knowledge of the advantages of general principles, and will convey information not readily ac-

cessible, and which, in reality, does not exist in the condensed form in which it will be here given.

Perhaps no branch of science has given rise to more speculation or excited a greater amount of angry controversy than that relating to the nature and interpretation of atmospheric phenomena. The former may arise from the dependence of man for health and comfort on the state of the weather, and the latter from the limited sphere of individual observation to which the cultivators of this branch are generally confined. While the astronomer, without quitting his observatory, if situated near the equator, can watch the motions of all the heavenly bodies as they present themselves in succession to his telescope, the meteorologist can only take cognizance of the changes which occur immediately around him, and hence the origin of partial views and imperfect generalizations. Controversies, however, in this science, as in most others, may frequently be referred to the partiality we entertain for the products of our own minds. Truth, as has been properly said, belongs to mankind in general; our hypotheses belong exclusively to ourselves, and we are frequently more interested in supporting or defending these than in patiently and industriously pursuing the great object of science, namely, the discovery of what *is*.

In the account of meteorology which it is proposed to give, the writer has no hypotheses or theories of his own to support, but will endeavor to confine his statements to the exposition of such principles as are generally recognized at the present day ; and if hereafter it shall be found that views have been presented in this paper which cannot be sustained, he will point out in the subsequent Reports the errors which may have been committed. The expounder of science, unlike the politician, is at liberty to change his opinions when they are found to be at variance with the actual condition of things. Indeed, in the investigation of nature, we provisionally adopt hypotheses as antecedent probabilities, which we seek to prove or disprove by subsequent observation and experiment; and it is in this way that science is most rapidly and securely advanced.

Some parts of our subject, as will be seen, are intimately connected with leading questions of the day; and on this account it might be considered prudent to avoid allusion to them. But the great aim of science is the discovery of truth ; and the proverbial veneration entertained for it by the human mind is a sure indication that truth, and the whole truth, will always be conducive to the real progress of nations or individuals, and that to present it simply as a proposition without special application is the best means of supplanting error. We hold in high veneration the plan of government established by the wisdom of our forefathers ; but we cannot be blind to the fact that it required a peculiar theatre for its application, a wide territory of fertile soil and genial climate, well fitted to reward the labors of the husbandman and to promote the health of his body and the vigorous activity of his mind. Next to our political organization, under Providence our prosperity has

mainly been promoted by the ample room afforded us for expansion over the most favored regions of this continent. It becomes, therefore, important for us to ascertain the natural limits, if there be any, to the arable portion of our still untenanted possessions, and to determine, if possible, what parts of it are best fitted, by climate and soil, for the future operations of the husbandman. The data do not exist at present for the definite solution of this problem; but it is one object of the systems of meteorology now in operation in this country to collect the facts by which it may be fully resolved. Agriculture as a science, in the United States, has up to this time been of comparatively little importance; refined processes of cultivation are not required where the products of millions of acres of virgin soil can be gathered without skill and with comparatively little labor. It is only when the organic power and material which Nature has thus stored up in the primitive earth have been to a greater or less extent exhausted, that scientific processes must be adopted in order to secure the continued production of ample harvests. The time is at hand when scientific agriculture can no longer be neglected by us; for, however large our domain really is, and however inexhaustible it may have been represented to be, a sober deduction from the facts which have accumulated during the last few years will show that we are nearer the confines of the healthy expansion of our agricultural operations over new ground than those who have not paid definite attention to the subject could readily imagine. We think it will be found a wiser policy to develop more fully the agricultural resources of the States and Territories bordering on the Mississippi, than to attempt the further invasion of the sterile waste that lies beyond.

The laws of nature are all simple and readily comprehended by a mind of ordinary capacity, when separately announced; but when the conditions under which they operate are varied, and a number of forces are called into action, the resulting phenomena frequently become so complex that their investigation transcends not only the ordinary logic of the most gifted mind, but even the more powerful analysis of the mathematician. It has been properly said, by Professor Peirce, of Cambridge, that, had the lot of man been cast upon one of the outer planets of our system, the phenomena of the motions of the heavenly bodies, as viewed from this point, would have been so complex and apparently irregular, that our present state of civilization, resting as it does on the principles of science, beginning with astronomy, the most perfect, would not have existed. Man would never have arrived at the definite idea and the conclusive evidence of the universality of causation, or, in other words, at the fact that, amid all the apparently confused and accidental occurrences that we observe, a few simple laws, which constantly diminish in number as our views become more extended, govern all events, whether they be those which we refer to order and succession, or those which, in our ignorance, we ascribe to chance. Astronomy is the most perfect of all the sciences, not only because it has been longest studied, but more especially because it

is the simplest exhibition of the laws of force and motion ; and yet, even in this science, where all the data are furnished, the introduction of a few conditions renders a problem too complex for direct solution. For example, to determine the path described and the time of revolution of a single planet round the central body by the application of the laws of motion and gravitation is a simple problem, which was solved at an early period in the history of astronomy. When, however, a third body was introduced, such, for example, as the moon, in addition to the earth and sun, the problem baffled for a long time the skill of the first mathematicians of the age ; and even yet a direct *a priori* solution of all the results which will be produced by the mutual action of a series of planets revolving round the sun has not been effected, and recourse is had to indirect methods of approximation. Had man confined his observations to the complex and multiform changes of the weather, the probability of his ever arriving at a definite law would be far less than even in the before mentioned case of astronomy; for, though we are assured that the motion of every atom of air is governed by the same laws which direct the heavenly bodies, yet the amount of perturbation and reciprocal action presented in the case of myriads of atoms renders the probability of a complete solution of the problem of the currents of the atmosphere, even with the greatest possible extension of human science, extremely doubtful. We must, therefore, be content with approximations deduced from general principles combined with the results of extended, precise, and definite observation.

The history of meteorology illustrates the fact, that what may be termed popular observations and experience, without scientific direction, seldom lead to important rules. The uneducated sailor of to-day, after three thousand years of experience, firmly believes that he can invoke the winds and entice them from the caves of Æolus by a whistle. Most of the aphorisms in reference to the changes of the weather, though of venerable antiquity, merely relate to the greater or less degree of moisture in the atmosphere. They declare what has happened, that a change has already taken place in the air, but give no certain indication of what is to occur. In order, therefore, to the successful study of meteorology, the results of *systematic* observations are to be compared with the deductions from well established principles of science, and the converse ; or, in other words, deduction and observation should constantly go hand in hand, the former directing the latter, and the latter correcting the conclusions of the former.

In meteorology, as in all other branches of science, the important rule adopted by Newton should never be neglected, namely: "No more causes are to be admitted for the explanation of any phenomenon, or class of phenomena, than are true and sufficient." Though a general principle which is in strict accordance with the established laws of force and motion cannot be immediately applied to the explanation of an isolated class of phenomena, it is not, on that account, to be set aside for some new and unknown agent. We

must look to further investigations for the light which shall enable us to perceive the connection. The undulatory theory of light connects so many facts, and has enabled the scientist to predict so many others which were previously unknown, that, though a few outstanding phenomena may still exist, they do not militate against our convictions of the truth of the generalization which this theory so admirably expresses; and we may safely attribute the apparent want of agreement to our ignorance of some essential condition of the phenomena in question, or to some error in the logical deduction from our principles. The history of science abounds in apparent exceptions to general rules, which, when better understood, become additional evidences in support of the general principle. The foregoing remarks will not be thought inapplicable on the present occasion by those who have studied the history of the progress of meteorology.

One of the most important general truths at which science has arrived by a wide and cautious induction, and which is the foundation of meteorology, is that nearly all the changes which now take place at the surface of the earth are due to the action of the sun. The forces which pertain to the earth itself—such as gravity, chemical affinity, cohesion, electricity, magnetism, &c.—are forces of quiescence; they tend to bring matter to a state of rest at the surface of the globe, from which it is only again disturbed by the solar emanation. All the elementary substances which constitute the surface of our planet, with the exception of the organic matter, have long since gone into a state of permanent combination. The rocks and various strata are principally composed of burnt metals. The whole globe is an immense slag, analogous to that drawn from the smelting furnace, surrounded by a liquid and an aerial envelope; the former in a state of ultimate chemical combination, and the active principle of the latter—the oxygen—finding nothing to combine with, except what has been released from a former combination by the action of the sun. If, therefore, the solar impulses were suspended, all motion on the surface of the planet would cease: the wind would gradually die away; the currents of the ocean would slacken their pace, and finally come to rest; and stillness, silence, and death would hold universal reign. We cannot, however, at present, pursue this thought, but must confine our remarks to the effects of those impulses of the sun denominated *heat* in their connection with meteorology.

All the phenomena referable to the rays of heat from the sun acting under varying conditions will now be considered, so far as they affect the climate of the United States, under two heads:

1. The effects of varying astronomical conditions, irrespective of atmospheric and other influences.
2. The effect of all conditions, other than astronomical, such as the influence of the air, the ocean, the land, &c.

RESULTS OF ASTRONOMICAL CONDITIONS.—The earth, in its annual revolution in its orbit round the sun, does not describe a perfect

circle, but an ellipse, of which the sun occupies one of the foci; and hence, we are nearer at one season of the year to this central luminary, than at another. It is well established, by mathematical investigation, from astronomical data, that, at the present historical period, the earth, as a whole, receives the greatest amount of heat, during any one day in the year, on the 1st of January, and the least amount on the 4th of July. The coincidence of the latter date with that of the anniversary of American Independence might by some be considered as an inauspicious omen. It should be recollected, however, that this statement refers to the whole earth, and not to the maximum of heat received on the surface of the United States. The variation in the distance of the sun produces no effect on the different seasons; since the rapidity of motion, or the less duration of proximity to the sun, just compensates for the greater intensity of the rays due to the nearer approach. Were it not for this, the eccentricity of the orbit would materially influence the heat of the seasons, since the fluctuation in the heating power of the sun's rays on this account amounts to one-fifteenth of the whole; and it does, in reality, increase the diurnal intensity for a few days in January, as is shown from the ardor of the sun's rays under a clear sky at noon in the southern hemisphere. One-fifteenth, says Sir John Herschel, is too considerable a fraction of the whole intensity of sunshine, not to aggravate, in a serious degree, the sufferings of those who are exposed to it, without shelter, in the thirsty deserts of the South. The accounts of what is endured in the interior of Australia, for instance, at this season, are of the most frightful kind, and seem far to excel what have ever been experienced by travellers in any part of the northern hemisphere.

Another astronomical deduction is, that the point of the earth's orbit which approaches nearest the sun is constantly changing its place, and in time the order will be reversed; the greatest amount of heat from this cause will be on some day in July, and the least in January. But this change is so slow, that no appreciable effect has been produced during the historic period. A slight variation also takes place in the distance of the earth and sun when nearest to each other; but this, also, is confined to such narrow limits, that it is entirely insufficient to account for the changes undergone in the earth's temperature, as indicated by fossil plants and animals, and cannot, on account of its slowness, have had any appreciable effect upon the temperature of any part of the earth since the first records of civilized man. If, therefore, it be true, as some suppose, that the seasons have changed in different parts of the earth within the memory of man, the effect must be due to other than to astronomical causes.

The earth is approximately a sphere, and, consequently, the sun's rays strike it obliquely at all places, except those over which it is precisely vertical. The amount of variation on this account can readily be calculated; the sun's beam may be considered as a force, and resolved into two parts, one of which is parallel to the

surface of the earth, and the other perpendicular to it, the latter alone producing the result. The intensity of the sun's beam will be the greatest at the equator, and will gradually diminish to the poles. It is true, the sun does not continually remain vertical at the equator, but the average result, in the course of the year, is nearly the same as if this were the case; since the greater amount of heat received while he is at the north just compensates for the less while at the south. The average temperature of any given place, in consideration of the obliquity of the rays which the earth would receive if uninfluenced by other conditions, can be obtained by multiplying its equatorial temperature into the radius of its parallel of latitude.

From this formula, which we owe to the celebrated savant, Sir David Brewster, we have calculated the following table, which exhibits the astronomical and observed temperatures of the valley of the Mississippi, along a line passing through the city of New Orleans:

Lat.	Astron. mean temp.	Observed temp. reduced.	Difference.
25°	74.32	74.50	+ 0.18
30°	71.01	69.00	— 2.01
35°	67.17	62.00	— 5.17
40°	62.81	53.00	— 9.81
45°	57.98	44.50	—13.48
50°	52.70	37.00	—15.70

The temperature of the equator is assumed to be 82°. The first column gives the latitude, the second the astronomical mean temperature, the third the observed temperature reduced to the level of the sea, as taken from the isothermal chart accompanying this Report, (see Plate IV,)and the fourth column the difference between the two last. It will be seen that the difference between the calculated and the observed temperature in the lower latitudes is quite small; but as the latitude increases, the deviation becomes very great. This difference is due to other than astronomical causes, and by eliminating the latter we narrow the field of research.

Empirical formulas of much nearer approximation to the truth in high latitudes have been proposed, which will be noticed hereafter, our object at present being only to exhibit the difference between the astronomical results and those derived from actual observation.

Let us next consider the changes of temperature, in different parts of the day and in different seasons of the year, produced by the varying obliquity of the sun's rays. If we assume a given length of sunbeam as the representative of the force, then resolve this into two,—one perpendicular, the other parallel to the horizon,—the sum of all the perpendicular lines, from the rising to the setting of the

sun, on any day, will represent the whole intensity of the heat on a given place during that day ; and in this way may be calculated the relative amount of heat received on different latitudes at different seasons of the year. From this estimate we shall find that the amount of heat received during a given day in summer, say the 16th day of June, from the sun, at different northern latitudes, is greater than that which falls upon the equator during the same time. This is exhibited in the following table, from the paper of L. W. Meech on the sun's intensity, in the 9th volume of the Smithsonian Contributions:

The sun's diurnal intensity at every ten degrees of latitude in the northern hemisphere.

A. D. 1853.	Latitude 0°.	Latitude 10°.	Latitude 20°.	Latitude 30°.	Latitude 40°.	Latitude 50°.	Latitude 60°.	Latitude 70°.	Latitude 80°.	Latitude 90°.
Jan. 1	77.1	67.2	55.8	42.8	30.1	16.5	5.1	------	------	------
Jan. 16	78.1	68.9	58.2	45.8	32.7	19.3	7.2	------	------	------
Jan. 31	79.6	71.7	61.9	49.7	38.6	25.0	11.9	1.4	------	------
Feb. 15	81.0	74.7	66.6	55.6	45.1	31.9	19.0	6.4	------	------
Mar. 2	81.6	78.0	71.3	62.9	52.7	41.1	27.9	14.5	2.1	------
Mar. 17	82.0	80.2	76.0	69.6	61.1	50.2	37.1	25.5	11.6	------
April 1	80.8	81.4	79.5	75.6	68.9	60.2	49.9	38.0	25.6	20.5
April 16	79.0	81.7	82.0	79.5	75.1	68.6	61.1	51.4	44.0	44.6
May 1	76.9	81.5	83.7	83.6	80.8	77.1	70.9	64.6	64.3	65.3
May 16	74.7	80.8	84.7	86.7	85.7	83.3	79.7	76.8	80.3	81.5
May 31	73.0	80.1	85.1	87.8	88.9	87.8	85.7	86.8	91.0	92.4
June 15	72.0	79.6	85.2	88.4	90.1	89.9	88.8	91.7	96.1	97.6
July 1	72.0	79.5	85.0	88.5	90.4	89.5	88.4	90.8	95.1	96.6
July 16	73.0	79.8	84.7	87.5	87.6	86.5	84.1	84.3	88.3	89.7
July 31	74.7	80.4	83.9	85.1	84.5	81.6	77.3	73.4	76.2	77.4
Aug. 15	76.7	80.8	82.7	82.4	79.8	74.7	68.2	60.9	59.2	60.1
Aug. 30	78.5	80.7	80.6	77.7	72.1	65.5	57.3	47.7	38.8	38.9
Sept. 14	79.8	79.8	77.5	72.8	65.9	58.8	46.9	34.5	21.9	14.7
Sept. 29	80.5	78.4	73.8	67.0	57.8	47.0	36.2	22.5	9.0	------
Oct. 14	80.7	76.4	69.7	61.0	50.2	38.2	25.7	12.6	1.0	------
Oct. 29	79.9	73.5	65.0	54.6	42.5	30.1	17.5	5.2	------	------
Nov. 13	78.8	70.7	60.8	49.8	37.1	23.8	11.0	0.9	------	------
Nov. 28	77.5	68.3	57.3	45.3	31.8	18.9	6.8	------	------	------
Dec. 13	76.9	66.9	55.4	43.0	30.3	16.3	4.9	------	------	------

On the fifteenth of June the sun is more than 23 degrees north of the equator, and therefore it might be readily inferred that the intensity of heat should be greater at this latitude than at the equator; but that it should continue to increase beyond this, even to the pole, as indicated by the table, may not, at first sight, seem so

clear. It will, however, be understood, when it is recollected that the table indicates the amount of heat received during the whole day; and though in a more northern latitude the obliquity of the ray is greater, and on this account the intensity should be less, yet the longer duration of the day is more than sufficient to compensate this effect, and to produce the result exhibited. This is an important fact, in comparing the agricultural capacity of different latitudes; for though there is absolutely more heat at the latitude of New Orleans during the year than at Madison, in Wisconsin, yet there is more heat received at the latter place during the three months of midsummer than in the same time at the former place. An analogous but contrary result is exhibited in regard to the cold of winters, as will be seen by the table. It is from this principle that, as we advance toward the equator, the extreme variations of the season become less and less. It is important to remark in this place that the foregoing tables exhibit the amount of heat actually falling upon the earth during the day as unmodified by any extraneous causes. They do not, however, exhibit the hottest portion of the season. This will depend upon another condition, which may be properly explained in this connection, though it is not classed under the astronomical causes. It is a well established principle that all bodies are radiating heat even while they are receiving it. If the amount received in a definite time is greater than that given off, the temperature will increase; on the contrary, if the amount given off is greater than that received, the temperature will diminish. The earth is constantly radiating heat into space, but only receiving it from the sun during the day. As the sun is declining towards the south, the daily amount received at length becomes less than that given off in the night, and hence the temperature begins to fall; and this diminution will continue until the two quantities again become equal, which will not be at the point where the greatest amount of heat is given off. On the twenty-first of June, in northern latitudes, the earth is receiving the greatest amount of heat, and hence it is becoming heated up most rapidly at this time. On the twenty-second, it receives a less amount of heat, but the heating continues, since the gain is still greater than the loss; and this goes on until about the 25th of July, or later, after which the radiation during the day and night together exceeds the amount received from the sun during the day, when the temperature begins to decline. The action is a little complicated, on account of the fact that the radiation increases with the temperature. A similar result is produced in the heating of the day, as will be seen from the following table of observations taken at every hour of the twenty-four, at Girard College, under the direction of Professor Bache:

MEAN DIURNAL VARIATION OF THE TEMPERATURE OF THE AIR AT PHILADELPHIA.

Computed from the observations made in 1842, *and from the* 1st *July*, 1843, *to the* 1st *July*, 1845.

1 A.M.	2 A.M.	3 A.M.	4 A.M.	5 A.M.	6 A.M.	7 A.M.	8 A.M.	9 A.M.	10 A.M.	11 A.M.	NOON
48.2	47.8	47.3	46.8	46.6	47.0	48.1	50.1	52.1	54.1	55.7	56.8

— Minimum.

1 P.M.	2 P.M.	3 P.M.	4 P.M.	5 P.M.	6 P.M.	7 P.M.	8 P.M.	9 P.M.	10 P.M.	11 P.M.	12 NIGHT.
57.9	58.6	58.9	58.7	57.7	56.0	54.1	52.5	51.0	50.2	49.4	48.7

\+ Maximum.

The result in the above table is somewhat affected by the greater humidity of the atmosphere towards morning, which prevents a greater radiation and fall of temperature, even after the rising of the sun.

Results of other than Astronomical Conditions.—The deductions that have thus far been given are from established astronomical data ; and, unless some error has been committed in the statement, their correctness cannot be doubted by any person properly educated in the line of physical science. The effects produced by the air, the water, and the land, are, however, of a much more complicated character, and, like the problem of the mutual action of all the planets on each other, have never yet been submitted to a successful mathematical analysis. In the investigation of a phenomenon, it is not enough that we explain how it is produced ; besides this, positive science requires that the explanation be true in measure as well as in mode, and, indeed, it is only when we can predict the exact amount of an effect, the principles being known, and certain data given, that a phenomenon can be said to be perfectly analyzed. We have seen in the preceding paragraphs that the meteorological phenomena produced by astronomical causes admit of relative numerical expression ; but in what follows we are obliged to content ourselves with the explanation in mode, and to refer to direct experiment and observation for the amount of the effect in measure. It is in this part of meteorology that so much uncertainty prevails, and in reference to which so much discussion, even of an excited character, has arisen. As was said before, the writer has no hypothesis of his own to advance, and will therefore confine himself to a statement, and in some cases a brief examination, of such hypotheses relative to the effects of the atmosphere, the ocean, &c., in modifying climate as have been suggested, and which appear to be in accordance with well established principles.

Effects of the atmosphere in a statical condition.—Were it not for the aerial envelope which surrounds our earth, all parts of its sur-

face would probably become as cold at night, by radiation into space, as the polar regions are during the six months' absence of the sun. The mode in which the atmosphere retains the heat and increases the temperature of the earth's surface may be illustrated by an experiment originally made by Saussure. This physicist lined a cubical wooden box with blackened cork, and, after placing within it a thermometer, closely covered it with a top of two panes of glass, separated from each other by a thin stratum of air. When this box was exposed to the perpendicular rays of the sun, the thermometer indicated a temperature within the box above that of boiling water. The same experiment was repeated at the Cape of Good Hope, by Sir John Herschel, with a similar result, which was rendered, however, more impressive by employing the heat thus accumulated in cooking the viands of a festive dinner. The explanation of the result thus produced is not difficult, when we understand the fact that a body heated to different degrees of intensity gives off rays of different quality. Thus, if an iron ball be suspended in free space, and heated to the temperature of boiling water, it emits rays of dark heat, of little penetrating power, which are entirely intercepted by glass. As the body is heated to a higher degree, the penetrating power of the rays increases; and, finally, when the temperature of the ball reaches that of a glowing or white heat, it emits rays which readily penetrate glass and other transparent substances. The heat which comes from the sun consists principally of rays of high intensity and great penetrating power. They readily pass through glass, are absorbed by the blackened surface of the cork, and, as this substance is a bad conductor of heat, its temperature is soon elevated, and it in turn radiates heat; but the rays which it gives off are of a different character from those which it receives. They are non-luminous, and have little penetrating power; they cannot pass through the glass, are retained within the box, and thus give rise to the accumulation of the heat. The limit of the increase of temperature will be attained when the radiation from the cork is of such an intensity that it can pass through the glass, and the cooling from this source becomes just equal to the heating from the sun. The atmosphere which surrounds the earth produces a similar effect. It transmits the rays from the sun, and heats the earth beneath, which in turn emits rays that do not readily penetrate the air, but give rise to an accumulation of heat at the surface. The resistance of the transmission of heat of low intensity depends upon the quantity of vapor contained in the atmosphere, and perhaps also on the density of the air. The radiation of the earth, therefore, differs very much on different nights and in different localities. In very dry places, as, for example, in the African deserts and our own western plains, the heat of the day is excessive, and the night commensurably cool. Colonel Emory states, in his Report of the Mexican Boundary Survey, that, in some cases, on the arid plains, there was a difference of 60° between the temperature of the day and that of the night. Indeed, the air is so permeable to heat,

even of low intensities, in this region, that a very remarkable difference was observed on some occasions when the camp-ground was chosen in a gorge between two steep hills. The inter-radiation between the hills prevented in a measure the usual diminution of temperature, and the thermometer in such a position stood several degrees higher than on the open plain.

We shall next briefly consider the mechanical constitution of the atmosphere. The aerial ocean which surrounds the earth consists of atoms of matter self-repellant, which, in proportion as the interior pressure is lessened, constantly tend to separate from each other, and produce an enlargement or expansion of the whole mass. When the pressure is increased, the mass sinks into a less volume, the atoms are brought nearer together, the force of repulsion is increased with the diminution of distance between the atoms, and a new equilibrium is attained. From this constitution of the air, it immediately follows that the density of the atmosphere near the surface of the earth is greater than that at a higher altitude, since the lower stratum bears the weight of all those which are above it. The diminution in weight of equal bulks of air as we ascend is in a greater ratio than the height, since it diminishes on two accounts: first, because as we ascend in the air the number of strata pressing on us is less; and secondly, each succeeding stratum is lighter. From the law of this diminution of density a table may be formed of the pressure of the atmosphere at various heights, of which the following is an example:

Density of the air at increasing altitudes.

Miles above the sea.	Bulk of equal weight of air	Density.	Height of barometer.
0	1	1	30.00
3.4	2	$\frac{1}{2}$	15.00
6.8	4	$\frac{1}{4}$	7.50
10.2	8	$\frac{1}{8}$	3.75
13.6	16	$\frac{1}{16}$	1.87
17.0	32	$\frac{1}{32}$	0.93

From this table it appears that one-half of the whole atmosphere is found within the limit of height of $3\frac{2}{5}$ miles, and one-third of the whole quantity beneath the level of the Rocky Mountains; and this fact has an important bearing on the influence of mountain ranges in modifying the direction of the winds.

The question occurs at this place, Why does the air grow colder as we ascend? The answer is, that a pound of air, at all distances above the earth, contains at least an equal amount of heat with the same weight taken at the surface, and that, as the pressure is removed, this air is expanded in bulk, and consequently the heat is diffused through a greater amount of space; and hence the reduc-

tion of its intensity, or temperature. To illustrate this, take a large ball of sponge and squeeze it into one-quarter of the space which it naturally occupies. In this condition dip it into water, it will imbibe a certain quantity of the liquid, and when drawn out will be dripping wet; now let it expand to its natural dimensions, the water will be distributed through a large amount of space, and the sponge itself will appear comparatively dry. Squeeze it again into its former condensed state, and it will appear wet; suffer it again to expand, and the apparent dryness will be resumed. In a like manner we suppose that, while the quantity of heat is the same, its intensity is increased by condensation into a smaller space, and diminished by the converse process. In the foregoing illustration the amount of water contained in the sponge represents the amount of heat in the air, and the degree of wetness produced by condensation the intensity of the temperature exhibited in diminishing the bulk of air.

It follows from this that the blowing of a current of air over a high mountain, provided it descends again into the plain, does not necessarily diminish its temperature. When it arrives at the top of the mountain, it will become as cold as the circumambient air, not because it has lost any of its heat, but because that which it contained is now distributed through a greater space; when it descends again to the plain, it will suffer a corresponding diminution of bulk, on account of the increased pressure, and with this the original temperature will be restored.

This principle, as we shall see hereafter, is of great importance in the study of the peculiarity of the temperature of the western portion of the territory of the United States. We have said that every pound of air, from the bottom of the aerial ocean to its surface above, contains at least an equal quantity of heat; and this was the inference of Dalton. From the investigations of Poisson and others it appears that the absolute quantity of heat, pound for pound, slightly increases rather than diminishes as we ascend; and this seems necessary to the stability of the equilibrium of the atmosphere as a whole. If the amount of heat were greater in the lower strata than in the upper, the equilibrium would be unstable, and an inversion would tend constantly to take place. An equal quantity of heat, pound for pound, as we ascend, would produce an indifferent equilibrium, while an increased amount, in the order of ascent, would produce a stable condition of the atmosphere, such as that which really exists. The question, however, has not yet been fully settled, although it is an important one, having a bearing on the explanation of many meteorological phenomena.

Another question of much interest is the exact law of diminution of temperature as we ascend into the air. Were this actually known, we could reduce to the same level all the observations which are made in a country; and thus, in addition to the astronomical effects, we could eliminate those due to altitude, and present the remainder as results which are due to the other conditions producing the peculiarities of climate. In order, however, to apply the

law with precision in this way, it is desirable that it should be determined from observations made by ascents in balloons or at points of different heights on isolated mountain peaks. Relative observations made for this purpose on the top and at the base ot mountain systems of considerable width and extent will probably give results involving the influence of the mountain surface itself, which, in turn, would be somewhat affected by the direction of the prevailing wind and other causes. The progress of meteorology will call for an increased number of observations of the proper character, and for the repetition of the experiments with balloons, in different parts of the earth.

Celestial space, in which our sun and the earth and other planets of our system are placed, is known, from different considerations, to have a temperature of its own, which is supposed to be the result of the interradiation of all the suns and planets which exist in every part of the visible universe. The temperature of this space is estimated to be about —60°. This fact being allowed, it will follow that, since the heat at the top of the air remains constant, the rate of decrease of temperature as we ascend will be diminished with the decrease of temperature at the surface of the earth, and also that the rate of decrease will follow a slightly diminishing ratio. At all accessible elevations in the atmosphere, however, it may be considered as almost constant. In some cases the rate of diminution is interfered with by abnormal variations of temperature ; for example, as we ascend into the region of the clouds, the latent heat evolved in the condensation of the vapor produces a local heat in the atmosphere beyond the natural temperature. In temperate latitudes it is usual to allow 300 feet of elevation for the reduction of temperature one degree of Fahrenheit's scale. This quantity was deduced from thirty-eight observations collected by Ramond. Boussingault found, from observation in the tropics, a diminution of 335 feet. Col Sykes, from mountain observations in India, a diminution of 332 feet. Saussure ascertained the mean value in the Alps to be 271 feet. Gay Lussac's celebrated voyage gave 335 feet. And the result of several series of observations with the balloon by Mr. Welch, under the direction of the British Association, omitting the points unduly heated by the condensation of vapor, was about 320 feet. In the construction of the isothermal chart which accompanies this Report, we have adopted 333 feet, or three degrees to one thousand feet, as the rate of diminution, and find, in comparing the temperature of different places of varying heights which have been reduced by it, that they afford very satisfactory corresponding results. We propose to give a fuller discussion of this part of the subject in another Report.

Motions of the Atmosphere.—The repulsion of the atoms of the air is not only increased by a diminution of distance from being pressed closer together, but also by an addition of heat. From the latest and most reliable experiments on this point it is found that, the pressure being the same, air expands $\frac{1}{491}$ part of

its bulk at the freezing point for each degree of Fahrenheit's scale. Heated air, therefore, becomes specifically lighter, and tends constantly to ascend, being pressed upwards by the heavier circumambient fluid. The effect thus produced upon the air by the impulses from the sun is the great motive power which gives rise to all the currents of the atmosphere, from the gentle zephyr which slightly ripples the surface of the tranquil lake to the raging hurricane which overwhelms whole fleets, or destroys in a moment the hopes of the husbandman for an entire season. This fact is so well established by science, that it is unnecessary to seek for any other *primum mobile* for the great system of constant agitation to which the aerial ocean is subjected.

Allowing the temperature of the equator, on an average, to be 82°, that of the pole zero, and of the top of the air, or, in other words, of celestial space, to be —60°, and estimating the height of the atmosphere at 50 miles, it will follow, from the law of expansion by heat, that the excess of elevation of the air at the equator will be upwards of four miles above that of the pole. Although this is not intended to present the exact amount of the aerostatic pressure, yet it will serve to show the great motive power constantly maintained by the influence of the solar radiation. In order to simplify the conception of the motions which result from this disturbing power, let us, in the first place, suppose the earth to be at rest, and its whole surface of a uniform character, consisting, for example, of water. It is obvious, from well established hydrostatic principles, that the air, expanded, as we have stated, at the equator, would flow over at the top, and descend, as it were, along an inclined plane towards the poles, would sink to the earth, flow back to the equator below, and would again be elevated in an ascending current; and thus a perpetual circulation from either pole to the equator, and from the equator back towards the poles, along the several meridians of the globe, would be the continuous result. It is further evident that, since the meridians of the earth converge, and the space between them constantly becomes less, all the air that rose at the equator would not flow along the upper surface entirely to the poles, but the greater portion would proceed north and south no further than the 30° of latitude; for the surface of the earth contained between the parallel of this degree and the equator is equal to that of half of the whole hemisphere. Portions, however, in the northern hemisphere, for example, would flow on, to descend at different points further north; and of these some would probably reach the pole, there sink to the surface of the earth, and from that point diverge in all directions in the form of a northerly wind. Between the two ascending currents near the equator would be a region of calms or variable winds, influenced by local causes. The currents which flow over towards the poles would descend with the greatest velocity at the coldest point; because there the air would be most dense, or, in other words, have the greatest specific gravity.

According to the view here presented, a section of the atmosphere

made by cutting through a meridian from pole to pole, perpendicular to the horizon, would exhibit two great systems of circulation: one from the north and another from the south to the equator below, rising at the latter place, and pouring over on either side to return again by longer or shorter circuits to the place whence they started. Such would be the simple circulation of the aerial ocean if no perturbing influences existed, and the whole science of meteorology would be one of comparatively great simplicity. But this is far from being the case. A number of modifying conditions must be introduced, which tend greatly to perplex the anticipation of results. First, the earth is not at rest, but in rapid motion on its axis from west to east. Every atom therefore of the current of air as it flows towards the equator in the northern hemisphere would partake of the motion of the place at which it started, and in its progress southward it would reach in succession latitudes moving more rapidly than itself. It would, therefore, as it were, fall behind continually, and appear to describe on the surface of the earth a slightly curvilinear course towards the west. A similar result would be produced on the south side of the equator; and hence we have the first conception of the cause of the great systems of currents denominated the "trade winds," blowing constantly within the parallel of 30° from the northeast in the northern hemisphere, and from the southeast in the southern, towards the belt of greatest rarefaction.

The motion, however, will require further consideration. The particles of air approaching the equator will not ascend in a perpendicular direction, as was first supposed, but will rise continually as they advance towards the west along an ascending plane, and will continue for a time their westerly motion in the northern hemisphere after they have commenced their return towards the north.

They will, however, as they advance northward, arrive at parts of the earth moving so much less rapidly than themselves, that they will gradually curve round towards the east, and finally descend to the earth, to become again a part of the surface trade wind from the northeast. The atoms will tend to move westward as they ascend: first, on account of their momentum in that direction; and secondly, because, as they reach a higher elevation, they will have less easterly velocity than the earth beneath. They will also be affected by another force, as has lately been shown by Mr. Ferrell, due to the increase of gravity which a particle of matter experiences in travelling in a direction opposite to that of the rotation of the earth. The last mentioned cause of deflection will operate also in a contrary direction on the atoms when they assume an easterly course.

The result of the complex conditions under which the motive power acts in such a case would be to produce a system of circuits inclined to the west; the eastern portion of which would be at the surface, and the western at different elevations even to the top of the atmosphere. To give definiteness to the conception, let us suppose a series of books to be placed side by side on edge, pointing to

the north: these books would represent the planes in which the currents of the air would circulate in the northern hemisphere, were the earth at rest; but if the earth is supposed to be in motion, then the books must be inclined to the west, so as to make an acute angle with the horizon, and overlap each other like the inclined strata in a geological model. If on each leaf of each book a circuit of arrows be drawn, then will the assemblage of these represent the paths of the different atoms of the atmosphere. The currents of air, however, would not be in perfect planes, but in surfaces which could be represented by bending the leaves to suit the curvature of the earth. In this manner would be exhibited the general motion of the wind, which has been determined by actual observation.

The greater portion of the circulation would descend to the earth within 30 degrees of the equator, giving rise to the trade winds; a portion would flow further north, and produce the southwest winds; another portion would extend still further northward, descend towards the earth as a northwest wind, and so on. The air which descends in the region of the pole would not flow directly southward, but, on account of the rotation of the earth, would turn towards the west and become a northeasterly current. At first sight it might appear that the north wind which descends from the polar regions would continue its course along the surface until it joined the trade winds within the tropics; but this could not be the case, on account of the much greater western velocity this wind would acquire from the rapidly increasing rotary motion as we leave the pole. There would, therefore, be three distinct belts in each hemisphere, namely: the belt of easterly winds within the tropics, the belt of westerly in the temperate zone, and the belt of northwesterly at the north. The existence of these belts has been clearly made out by Professor Coffin in calculating the resultant of all the winds of the northern hemisphere, or, in other words, by eliminating the effects of extraneous action, and exhibiting the residual as the result produced by the general circulation.

Another condition, however, must be introduced. These belts would not be stationary, but would move laterally towards the south or the north, according to the varying positions of the sun at different seasons of the year. Their breadth would also vary; because they would be crowded into a smaller space towards the pole in the winter, and expanded into a wider space in the summer.

To trace with precision, while under these varying perturbing influences, the path which would be described by a particle of air in its circuit, transcends the power of unaided logic, and can only be accomplished, if at all, by means of the most refined mathematical artifices. This problem has lately, it is believed, been presented as one of the prize questions of the French Academy of Sciences. Were it, however, solved, with all the conditions that have been assigned, this would not be sufficient; since there is another cause of disturbance, perhaps more active than any yet enumerated, namely: the condensation of the vapor which arises from the surface of the ocean and is carried to different parts of the earth by the

currents described. We owe to Mr. Espy, of this country, the principal development of the action of this agent in modifying and controlling atmospheric phenomena. The heated air which ascends at the equator is saturated with moisture, which it has absorbed in its passage over the northern and southern oceans. As it ascends above the surface of the earth it meets continually with a diminished temperature; and a considerable portion of it daily, as the sun declines into the west, is converted into water, which returns to the surface in the form of rain. The greatest effect of this action is immediately beneath the sun; and hence the belt of intertropical rains oscillates to the north and south with the course of the sun in its annual changes of declination. A portion, however, of the same vapor is probably carried by the upper current far beyond the tropics, and deposited in fertilizing rains even at the extremities of the polar circles.

The condensation of the vapor which ascends in the equatorial regions evolves an astonishing power, in the form of heat, which accelerates the upward motion of the air, and modifies, in a greater degree than almost any of the causes we have heretofore mentioned, the primary motion, due simply to the difference of heat between the poles and the equator. To understand this, it is sufficient to refer to the great amount of heat contained in a given amount of steam; and for illustration let us suppose the following simple experiment: A quantity of water at the temperature of melting ice is placed in a vessel over a lamp, which is so adjusted as to impart one degree of heat to the water in each minute of time. If the process is properly conducted, the heat will continue to increase, and, in accordance with the supposition we have made, the water at the end of about twelve hundred minutes will be all converted into vapor. If the process has been so conducted that a degree of heat has been given to the liquid in each minute of time, the steam will evidently contain about twelve hundred degrees of heat above the zero of Fahrenheit's scale. The greater portion of this will be in what is called a "latent" state; but it will all reappear, as is well known from abundant experiments, when the vapor is reconverted into water. From these data it is easy to prove mathematically that every cubic foot of water which falls on the surface of the earth in the form of rain leaves in the air whence it descended sufficient heat to produce at least 6,000 cubic feet of expansion of the surrounding atmosphere beyond the space which the vapor itself occupied. The ascensional force evolved by this process must evidently be immense, when we consider the great amount of rain which falls within the tropics. A similar power is evolved whenever rain falls; and this principle, which has been so ably developed by Mr. Espy, is undoubtedly a true and sufficient cause of most of the violent and fitful agitations of the atmosphere which have so long puzzled the scientific world. It, however, in its turn, will probably require the consideration of modifying conditions in its applications; and while at present the data are known with sufficient precision to warrant the assumption of the evolution of the

immense force we have mentioned, they are not in all cases sufficiently well determined to enable us to predict, with numerical accuracy, the results which have been shown to proceed from them. The same principle of condensation of vapor and evolution of heat is fertile in the explanation of the approximate cause of rain: for example, so long as the wind blows over a surface of uniform height and temperature, there is no cause to induce it to precipitate its vapor; but if in its course it should meet a mountain, the slope of which it is obliged to ascend, the vapor will be condensed on the windward side by the cold due to the increased vertical height. The latent heat will be evolved, the circumambient air will be abnormally heated, and an upward motion will ensue, towards which air will flow with increasing velocity to restore the equilibrium of the ascending column. In this way Mr. Espy explains very satisfactorily the fact that the wind blows over the desert of Zahara to supply the diminished pressure occasioned by the rains over the windward side of the Himalayah mountains. The same principle is immediately applicable to the explanation of the rainless districts in South America, Mexico, and other portions of the earth. The air, as it ascends the windward side of the mountains, deposits its moisture; and if the elevation is sufficiently high, it will pass over in a desiccated condition.

The idea that mountains attract vapor, is not founded on any well established principle of science. Molecular attraction extends only to imperceptible distances, and the attraction of gravitation is too feeble a force to produce results of this kind. The evaporation of water, and the transfer and subsequent condensation of the vapor in other parts of the earth, is undoubtedly the most active cause which produces the continual and apparently fitful changes of the weather.

We have stated that within the torrid zone there exists a belt of rain, produced by the partial condensation of the vapor which ascends with the air of this region; and since the sun between the 21st of March and the 21st of June passes from the equator to 23½ degrees north, and then makes a similar excursion as far south, the rainy belt follows his course, and hence all countries within the tropics must have periodically a rainy season.

The air, also, which flows over to the north, and which, as we have seen, descends to the earth in the westerly belts of wind, carries with it a portion of vapor, and deposits it in the form of rain; and hence, there is a tendency to a rainy and dry season beyond the tropics, which oscillates north and south with the varying motion of the sun. This tendency to regularity of rain is in many places masked or neutralized by the configuration of the country. It is, however, distinctly marked on the western coast of the United States and of Europe, as well as in various other places in the north temperate zone. Oregon and California have their rainy belt, which descends to the south in the winter, and again returns in the spring. In Lisbon, the number of rainy days in December is 55, to 2 in July; in Palermo, 37, to 2½ in

July. In Algiers, which is also north of the tropic, but further south, from the average of ten years, there are 88 rainy days in January, and, on the other hand, only a single one in July. Another fact of interest with regard to the extra-tropical belt of rain is, that it commences sooner at greater elevations above the surface: for instance, at the peak of Teneriffe, the rainy season commences at the top a fortnight earlier than at the bottom; so that, while rain is falling in abundance on the summit, the country in the vicinity of the mountain, at the level of the sea, is enjoying sunshine and a balmy atmosphere. The latter results, according to Mr. Espy's views, from the radiant heat given off by the condensing vapor above. The sun, however, descending still further to the south, brings down the rain belt to the level of the earth in this latitude, and the rainy season then commences. Similar phenomena have been observed on the higher parts of the coast range of mountains of California; and indications of a like action are witnessed on the higher peaks of the Appalachian chain. Besides the causes of the general perturbations of the atmosphere which we have thus given in considerable detail, some authors have added magnetism and electricity, and others have indeed attributed some of the principal effects we have mentioned to these agencies; but the present state of science does not warrant us in considering these as true or sufficient causes, except in the case of thunder storms, and perhaps tornadoes, in which the electricity evolved by the action of the storm itself may modify some of the results. Electricity, however, probably plays a subordinate part; since it is itself a consequence, and not a cause.

Terrestrial magnetism has not been shown in any case to affect meteorological phenomena; it is a force which never produces translation, but merely direction of the needle. The air in its natural condition is not magnetic, in the proper sense of the term, any more than a piece of steel wire is so before the power has been developed in it by a magnet.

We are not allowed, in strict scientific investigations, to explain a phenomenon by referring it to any agent, unless we show, in accordance with the laws of that agent, that it is capable of producing the result; and consequently magnetism is here not admissible.

Currents of the Ocean.—We have seen the effect of the unequal heating of different parts of the earth by the sun in giving rise to great gyrations of air; and it must be evident that there is a tendency to produce a similar result in the aqueous envelope of the globe. Let us first suppose the ocean to cover the whole earth, of a uniform depth, and uninterrupted by continents. If the earth were at rest and the heat of the surface at the equator could extend down sufficiently into the depths of the water, the latter would be expanded and would stand higher in the equatorial regions than in those of the poles; a current, therefore, as in the case of the air, would be established in both directions, towards the north and south, from the equator, which

would be cooled in its passage, would sink to the bottom, and return again to its starting point, to commence the same course anew. If we now suppose the earth, as in the case of the atmosphere, to be put in motion around its axis towards the east, the bottom currents, or those flowing towards the equator, coming from a part of the earth moving slower to a part going faster, would fall behind, and thus assume a westerly direction. They would, therefore, ascend obliquely in a westerly direction towards the surface, flow back towards the pole, (in their course curving constantly towards the east,) and as they cooled would sink down towards the bottom, to return again to the equator. Different portions of the upper surface of the current, as in the case of air, would continue their northerly course obliquely, and descend at intervals, some reaching nearly to the poles.

The result of the whole of this action would be a series of gyrations to the north and south, with the upper portion turned towards the west, forming a continuous circuit at the equator round the whole earth in a westerly direction, and a circuit in each temperate zone from the west. This would be the result, if the water could be heated to a sufficient depth; and, accordingly, it is considered by some that heating the water is the principal cause of the currents of the ocean (on which account we have so described it). Yet, though doubtless a true, I do not consider it a sufficient cause, but would mainly ascribe the currents of the ocean to the action of the winds in the belts of the equator and in the two temperate zones.

The constant westerly winds on either side of the equator would tend to produce a westerly current around the earth, provided no obstructions existed to its free course; but if, instead of considering the earth as entirely covered with water, we suppose the existence of two continents, extending from north to south, forming barriers across the current we have described, and establishing two separate oceans, similar to the Atlantic and Pacific, then the continuous current to the west would be deflected right and left, or north and south, at the western shore of each ocean, and would form four immense circuits, namely: two in the Atlantic, one north and the other south of the equator, and two in the Pacific, similar in situation and analogous in direction of motion. For a like reason, there will be a tendency to produce a similar whirl in the Indian ocean, the current from the east being deflected down the coast of Africa, and returning again into itself along a southern latitude on the western side of Australia. Besides these great circulating streams, the water supplied by all the rivers emptying into the Arctic basin, as well as that from all the precipitation in this region, returns to the south, and by the motion of the earth must tend westwardly in a current along the eastern shore of each continent between it and the stream flowing to the north. Similar currents, but more diffuse and less in amount, must constantly flow from the Antarctic regions.

We do not mean to assert that these whirls can be continuously traced on the surface of the ocean, though by attentively examining the maps their general outline can be marked out. We wish to convey an idea of the general tendency of the motions of the aqueous covering of the globe,—the central thought, as it were, on which they depend. The regularity of their outline will be disturbed by the configuration of the deflecting coasts and the form of the bottom of the sea, as well as by islands, irregular winds, difference of temperature, and, above all, by the annual motion of the sun as it changes its declination. The effect of these currents in modifying the climate of different parts of the world has long been recognized, though the detail of the mode in which this is produced has not until recently been pointed out. The Gulf stream of the North Atlantic carries the warm water of the equator beyond Iceland and the northern extremity of Europe, and it may even be traced to the shores of Nova Zembla. Without its influence the climate of Norway, Great Britain, and the western coast of Europe, would be as

cold as that of the corresponding parallels of latitude on the North American continent. In like manner, the great circuit of the waters of the Pacific conveys the warmth of the equator along the

eastern coast of Asia to Kamtchatka, and, gradually cooling in its course, descends along the northwest coast of the North American continent, to receive a new accession of heat and be again conveyed to the north. The total result of this circulation, in the northern hemisphere, together with those of lesser influence, is shown in the annexed polar projection, in which the series of irregular lines, marked 50°, 32°, 16°, and 0°, indicate the mean annual temperature of the points through which they pass, and are called the yearly isothermal lines, or, in other words, lines of equal heat.

The darker line, marked 32°, indicates the boundary of the region within which the average temperature is below the freezing point. It will be seen at a glance that, instead of being circular in its outline, it has the form of an irregular elongated ellipse, the greater diameter of which is across the pole, from the southern extremity of Hudson's Bay to the south of Lake Baikal, in Siberia. It extends some degrees lower to the south in Asia than in America. The shorter diameter of the ellipse is at right angles to the longer, and passes from near Behring's Straits, through the pole, to the open ocean west of Norway. Its longer diameter is nearly twice that of its shorter, and is in the direction of the greatest amount of land in the polar regions. This form of the curve, and the peculiarities of the other curves, are due principally to the currents of the Atlantic and Pacific oceans transporting the water from the equator to the north, and carrying with it the higher temperature. An elliptical dotted line will be perceived in the polar regions, the centre of which does not coincide with the geometrical axis of the earth, but is nearer the continent of North America than that of Asia, thus indicating that the coldest point on the earth's surface is a number of degrees south of the pole. It is true, this region has never been visited by man; yet knowing the law of the diminution of heat, and the form of the other lines, the smaller one can be drawn with considerable accuracy. It may be interesting to remark in this place that the mean temperature of the coldest part of the northern hemisphere has almost exactly the temperature of the Zero of Fahrenheit's scale—a remarkable although entirely accidental coincidence.

We have thus far almost exclusively confined our remarks to the general principles of science on which the phenomena of meteorology depend; we shall now give special attention to the application of these principles to the peculiarities of the climate of the continent of North America, and more particularly to that part of it which includes the territory of the United States. For this purpose it will be necessary to give a brief sketch of the topography and surface of the country.

Physical geography of the United States.—The climate of a district is materially affected by the position and physical geography of the country to which it belongs. Indeed, when the latitude, longitude, and height of a place above the sea are given, and its position relative to mountain ranges and the ocean is known, an approximate estimate may be formed as to its climate. The North American

continent extends across nearly the whole breadth of the nominal temperate zone, and has an average width of more than fifty degrees of longitude. The general direction of the eastern coast of the United States lies in a circle passing through Great Britain. Hence, a ship, while sailing along this coast, is on its direct route to the British isles. This fact—which is not clearly exhibited on the flat surface of a map, but is shown on the convex surface of a globe—has a bearing, not only on commerce, but also on the direction of the Gulf Stream, which conforms to the general direction and sinuosities of the coast. It will be seen by the map, Plate IV, which accompanies this Report, and to which constant reference should be made in reading the brief descriptions here given, that the eastern coast of the United States exhibits three great indentations, or large bays: the first commencing at the extremity of Florida, and extending to Cape Hatteras; the second, from Cape Hatteras to Cape Cod; and the third, from Cape Cod to Cape Sable. These bays, or great concave indentations, have a marked influence on the cold polar current which descends along the coast, and also, as has been shown by Professor Bache, on the great tide-wave of the Atlantic ocean, as it approaches our shore. At the southern extremity of the United States is the great elliptical basin containing the perpetually heated waters of the Gulf of Mexico, an enormous steaming cauldron continually giving off an immense amount of vapor, which, borne northward by the wind of the southwest, gives geniality of climate and abundant fertility to the eastern portion of our domain. On the western side of the continent the coast presents, as a whole, an outline of double curvature, principally convex to the west in that part which is occupied by the United States, and concave further north. These bends of the coast-line and of the adjacent parallel mountain ridges affect the direction of the winds in this quarter, and consequently of the ocean currents. The Gulf of California at the south, between the high mountains of the peninsula of that name and those of the main land, must also modify materially the direction of the wind in that region.

The continent of North America is traversed in a northerly and southerly direction by two extensive ranges of mountains—the Alleghany system on the east and the Rocky Mountain system on the west. We give the latter name to the whole upheaved plateau and all the ridges which are based upon it. These two systems separate from each other more widely as we pass northward, and between them is the broad interval which, within the territory of the United States, is denominated the valley of the Mississippi; but in reality the depression continues northward to Hudson's Bay, and even to the Arctic ocean, giving free scope to the winds which may descend from that inhospitable region. It, however, may be divided into two great basins, one sloping towards the south, comprising the basin of the Mississippi, and the other sloping to the north, including the basins of Mackenzie's river and of Hudson's Bay, the dividing swell which may be traced along the heads of the streams having an elevation of about 1,200 feet. Our remarks must be

principally confined to the portion of the continent south of the 49th degree of latitude, and delineated on the map to which we have before referred. (Plate IV.)

The swell of land, or watershed, on which the Alleghanies are situated, has an elevation, on an average, of at least 3,000 feet, although the ridges and mountains based upon it rise to a much higher elevation. The loftiest point is Clingman's Peak, of the Black Mountains, in North Carolina. It has lately been measured by Prof. Guyot, and is found to have a height of 6,702 feet. The next greatest elevation is Mount Washington, the highest peak of the White Mountains, in New Hampshire, which, according to the same authority, has an elevation of 6,285 feet. The lowest depression in this watershed, with the exceptions to be next mentioned, is in Pennsylvania, and has an elevation of a little less than 2,000 feet. Further north the whole system is cut through by the valley of the Hudson nearly to its base, and also by the valley of the St. Lawrence. The latter, together with the basins of Lakes Ontario and Erie, form a narrow trough between the Atlantic and the Mississippi valley, along which the flow of air may locally affect the climate. The position of the Alleghany Mountains, however, does not as much affect the meteorology of the country as from the magnitude of the system we might at first suppose; and this results from the fact that their direction is from the southwest towards the northeast, which, as we shall see hereafter, is the prevailing direction of the fertilizing wind of the United States. They do not, therefore, obstruct its course; it flows on either side of them and along the valleys between them. They do, however, in a considerable degree, modify the character of the easterly winds as felt upon the coast, depriving them of their moisture.

By a reference to the map accompanying this Report, compiled from the surveys of the officers of the Topographical Corps of the U. S. Army, the fact will be shown that the Rocky Mountain system occupies one-third of the entire breadth of the United States, and that the remaining two-thirds are divided into nearly two equal portions by the Mississippi river, beginning at its source. This great western mountain system of the North American continent, which produces the most important modifying influence on the climate of the United States, may be described as a broad, elevated swell or plateau of land, the prolongation of the base of the system of South America, to which the Andes belong, extending northward in the general direction of the Pacific coast, with varying elevation and width, to the Arctic circle. It occupies nearly the whole breadth of Mexico, from the Rio del Norte to the Pacific, and, as it extends northward, becomes still broader, occupying at the latitude of 40°, as has just been said, one-third of the breadth of the whole continent. Resting upon this great swell of land is a series of approximately parallel ridges, the principal of which are the Rocky Mountain ranges on the east and the Coast ranges on the west, with ridges of less magnitude between, the general direction of which is north, inclining towards the west. Between these ranges are a series of

extensive elevated valleys of extreme dryness, and, in the summer, of intense heat.

As we proceed north from the high plains of Mexico, the base of the system declines to about the 32d parallel of north latitude, where its transverse vertical section presents the least amount of land above the general level. It has, however, an average elevation in the principal part of about 4,000 feet, and the lowest notch or pass in the ridge on the eastern side is 5,717 feet above the ocean. Along the 35th parallel the vertical section across the mountain system is considerably greater in width and elevation. The general height above the ocean is at least 5,500 feet, and the lowest pass of the principal ridge is here 7,750 feet. The section of the system between the parallels of 38° and 40° has an elevation of 7,500 feet, and the lowest notch in the principal ridge is 10,032 feet above the level of the sea. From this section, as we pass to the north, the altitude and width decline; and along the parallel of about 47° the mountain base is much contracted in breadth, and has a general altitude of 2,500 feet. The lowest pass, however, of the most elevated ridge of this section is 6,044 feet. We have no definite information as to the mountain base north of this line. It however appears to continue at a lower elevation, and consequently to produce less influence upon the climate of the country to the east of it than the portion within the boundary of the United States.

From the eastern edge of what we have called the mountain system—that is, from the foot of the Rocky Mountain chain to the Mississippi river—a space comprising, as was said before, about one-third of the whole territory of the United States, the surface consists of an extended inclined plain, which slopes eastward to the Mississippi and southward to the Gulf of Mexico, having at the greatest elevation, near the intersection of the parallel of 40° and longitude 105°, a height of upwards of 5,000 feet, whence it gradually declines to the Mississippi river to about 1,000 feet. At the parallel of 35° it has very nearly the same elevation; and thence it slopes to the bed of the Mississippi about 450 feet, and south to the level of the sea at the Gulf of Mexico. This extended plain is traversed by a number of approximately parallel rivers flowing east and southward to the Mississippi river and the Gulf of Mexico, which have their rise principally in the mountain system, and are chiefly supplied by the melting of the snow and the precipitation of vapor which takes place at the summit of the ridges. The rivers are sunk deeply below the general surface of the plain, and give no indication of their existence from a distance, except the appearance of the tops of the cotton-wood trees which skirt their borders. The surface towards the southeast is slightly diversified by a low range of mountains, denominated the Ozark, which probably have some slight influence on the local climate of Kansas.

General Character of the Surface.—The general character of the soil between the Mississippi river and the Atlantic is that of great fertility, and as a whole, in its natural condition, with some exceptions at the west, is well supplied with timber. The portion also on the

western side of the Mississippi, as far as the 98th meridian, including the States of Texas, Louisiana, Arkansas, Missouri, Iowa, and Minnesota, and portions of the Territory of Kansas and Nebraska, are fertile, though abounding in prairies and subject occasionally to droughts. But the whole space to the west, between the 98th meridian and the Rocky Mountains, denominated the Great American Plains, is a barren waste, over which the eye may roam to the extent of the visible horizon with scarcely an object to break the monotony. From the Rocky Mountains to the Pacific, with the exception of the rich but narrow belt along the ocean, the country may also be considered, in comparison with other portions of the United States, a wilderness unfitted for the uses of the husbandman; although in some of the mountain valleys, as at Salt Lake, by means of irrigation, a precarious supply of food may be obtained sufficient to sustain a considerable population, provided they can be induced to submit to privations from which American citizens generally would shrink. The portions of the mountain system further south are equally inhospitable, though they have been represented to be of a different character. In traversing this region, whole days are frequently passed without meeting a rivulet or spring of water to slake the thirst of the weary traveller. Dr. Letherman, surgeon of the United States army, at Fort Defiance, describes the entire country along the parallel of 35° as consisting of a series of mountain ridges, with a general direction north and south inclining to the west, and broken in many places by deep cracks, as it were, across the ridge, denominated cañons, which afford in some cases the only means of traversing the country, except with great labor and difficulty. The district inhabited by the Navajo Indians has had the reputation of being a good grazing country, and its fame has reached the eastern portions of the United States; but, taking the region at large, it will be found that, with regard to abundance of natural pasturage, it has been vastly overrated, and we have no hesitation in stating, says the same authority, that were the flocks and herds now belonging to the Indians doubled, they could not be sustained. There is required for grazing and procuring hay for the consumption of animals at Fort Defiance, garrisoned by two companies, one of which is partly mounted, fifty square miles; and this is barely sufficient for the purpose. The barrenness and desolation so inseparably connected with immense masses of rocks and hills scantily supplied with water, are here seen and felt in their fullest extent. The character of the district lying across the mountain system along the 32d parallel, which has been still more highly lauded for its productiveness, is, from reliable accounts, in strict accordance with the *a priori* inferences which may be drawn in regard to its climate from the influence of the mountain ranges and the direction of the prevailing winds. Dr. Antisell, geologist to one of the exploring expeditions, describes the country along the parallels of 32° and 33° as equally deficient in the essentials of support for an ordinary civilized community. On the west, within these parallels, occurs the great Colorado desert, extending to the

river of the same name, which empties into the Gulf of California. From the Colorado river, which is generally regarded as the eastern edge of the Colorado basin, in its southern portion, the land rises eastward by a series of easy grades, until the summit of the main ridge of the mountain system is gained, a point about 500 miles east of that river. For the first 250 miles the ascent is across a series of erupted hills, of comparatively recent date, and similar in constitution to the line hills and ridges which are dotted over the various levels of the basin country. The entire district is bare of soil and vegetation, except a few varieties of cactus. Over the greater portion of the northern part of Sonora and the southern part of New Mexico sterility reigns supreme.

At the mountain bases may exist a few springs and wells, and in a few depressions of the general level of the surface sloping to the Pacific may be a grassy spot; but such are the exceptions. A dry, parched, disintegrated sand and gravel is the usual soil, completely destitute of vegetable matter and not capable of retaining moisture. The winter rains which fall on the Pacific coast, west of the Coast range of mountains, do not reach to the region eastward. This is partly supplied with its moisture from the Gulf of California, but chiefly by the southeast wind from the Gulf of Mexico, flowing up between the ridges of mountains. We hazard nothing in saying that the mountains, as a whole, can be of little value as the theatre of civilized life in the present state of general science and practical agriculture. It is true that a considerable portion of the interior is comparatively little known from actual exploration; but its general character can be inferred from that which has been explored. As has been said before, it consists of an elevated swell of land covered with ridges running in a northerly direction inclining to the west. The western slopes, or those which face the ocean, are better supplied with moisture, and contain more vegetation, than the eastern slopes; and this increases as we approach the Pacific, along the coast of which, throughout the whole boundary of the United States to the Gulf of California, exists a border of land of delightful climate and of fertile soil, varying from 50 to 200 miles in width. The transition, however, from this border to a parallel district in the interior is of the most marked and astonishing character. Starting from the sea-coast and leaving a temperature of 65°, we may, in the course of a single day's journey, in some cases, reach an arid valley, in which the thermometer in the shade marks a temperature of 110°. We have stated that the entire region west of the 98th degree of west longitude, with the exception of a small portion of western Texas and the narrow border along the Pacific, is a country of comparatively little value to the agriculturist; and, perhaps, it will astonish the reader if we direct his attention to the fact that this line, which passes southward from Lake Winnepeg to the Gulf of Mexico, will divide the whole surface of the United States into two nearly equal parts. This statement, when fully appreciated, will serve to dissipate some of the dreams which have been considered as realities as to the destiny of the western part of

the North American continent. Truth, however, transcends even the laudable feelings of pride of country ; and, in order properly to direct the policy of this great confederacy, it is necessary to be well acquainted with the theatre on which its future history is to be enacted and by whose character it will mainly be shaped.

Temperature.—Let us now consider the distribution of temperature of the wide belt across the continent of North America which forms the territory of the United States. To illustrate this, especial attention is requested to the lines drawn from east to west across the small map so frequently referred to. (Plate IV.) These, it will be seen, are of three kinds: first, the black, indicating the mean or average temperature of the year ; second, the red, denoting the mean temperature of summer ; and, third, the blue, that of winter. These lines are drawn through portions of the earth's surface having equal temperatures for the periods mentioned, and are protracted from the result of numerous observations. They do not, however, in all cases exhibit the actual temperature of the surface ; for, in order to show their relations, and render them comparable with each other and with similar lines in other parts of the world, it is necessary that the observed temperatures in elevated positions should be reduced to that of the level of the sea ; and in the construction of this map, allowance has consequently been made for decreasing temperature of one degree for every 333 feet of altitude. The map, therefore, will present to the eye the lines along which the temperature of the air would be equal for the periods mentioned, were we to suppose the mountain ranges entirely removed and the air brought down to the level of the ocean.

These lines, at a glance, exhibit remarkable curvatures, particularly in the western portion of the United States, indicating a great increase of temperature in this region beyond that of the eastern and middle portion. Let us first consider the black lines representing the mean temperature of the year. These, and indeed all the lines, are given for each ten degrees of Fahrenheit. Too much complication would be introduced were lines drawn for intermediate degrees on so small a map, though they have been projected on a larger one from which this has been reduced.

The first black line, beginning at the top of the map, is that of the mean temperature of 40°. It commences near the northern part of Nova Scotia, passes through Canada and the middle of Lake Superior, slightly diverging from parallelism with the line of 45° of latitude until about the 95th meridian, when it more rapidly curves northward and leaves the United States for the British possessions at about the 103d meridian, passing out at the top of the map at the 110th. The next line of mean temperature is that of 50°. It commences a little south of Nantucket, passes almost directly west, nearly parallel to the line of the 40th degree of north latitude, to about the 95th meridian of west longitude, whence it curves more rapidly to the north, meeting the coast of the Pacific in about the 48th degree of north latitude, near Puget's Sound. It thus exhibits the fact that the mean temperature of a point near

Rhode Island is the same as that at a point on the Pacific, of at least six degrees of latitude further north. The next line of mean temperature for the year, given on the map, is that of 60°; commencing near the mouth of Chesapeake Bay it inclines a little downward toward the 35th parallel of latitude until the meridian of about 98°, whence it rapidly ascends to the north, gains its greatest altitude at the 115th meridian, thence gradually declines southward to about the 125th, and thence, with a remarkably short bend, it passes parallel to the coast to about the latitude of 34°. By comparing the course of this line with that of the 35th parallel, it will be seen that the mean temperature is a little less near the Mississippi river than it is on the seaboard; but that in the great mountain system, in the same latitude as the mouth of the Chesapeake, the temperature of a place is nearly equal to 70° instead of 60°, since the curve of 70° reaches almost as far north. The curve of the mean temperature of 60°, as has been stated, terminates on the shores of the Pacific, at about latitude 34°; whereas, on the Atlantic, it commences at about 37°, indicating a lower temperature along the 35th parallel of latitude on the Pacific than on the Atlantic shore. The next is the curve of 70°. This commences in about latitude 28° on the coast of Florida, passes through New Orleans, and thence to a point on the Pacific in the latitude of 30°. It presents an upward curvature in that portion which passes through the Gulf, indicating that New Orleans is warmer than a corresponding place on the Atlantic, or on the shores of Texas. It thence curves rapidly to the north, though indicating the greatest temperature near the eastern edge of the mountain system. It terminates on the Pacific at a point at least two degrees higher than its point of commencement on the Atlantic, thereby indicating that along the 30th parallel the mean temperature is a little greater on the east than on the west side of the continent. It should be constantly borne in mind, in these descriptions, that the temperatures are those which would be exhibited were the mountain system of the country removed and the whole reduced to the level of the ocean. This system of lines, therefore, exhibits the extraordinary fact that, eliminating the effect due to elevation, there remains a cause of a remarkable degree of abnormal heating beyond that due merely to the latitude of the place. In other words, that at every point within the mountain system, whatever may be its elevation, the temperature is far above that of the same elevation of a point in free space having the same latitude, when compared with the eastern and western coast.

The red lines indicate the temperatures of summer. The first of these given on the map is that of 70°, and commences near Long Island, ascends rapidly towards the north, and then descends towards the large lakes, passing through Lake Erie; it reaches its greatest northern declination at about the 110th meridian, and thence turning nearly parallel to the coast, meets the Pacific in the latitude of about 34°. The portion of this curve along the coast of the Pacific shows the remarkable fact, that the summer temperature is nearly

the same from latitude 32° to 45°, or through a distance of 13 degrees, the whole having the same temperature as that of 41° on the Atlantic coast. This curve also clearly exhibits the great effect which the vicinity of the lakes has on the temperature of summer. While the black lines indicating the mean temperatures of 40° and 50° are not at all affected by their proximity to these large bodies of water, the mean temperature of the summer is materially reduced. We may here call attention to the fact that the blue line, denoting the winter, suddenly bends up at the same place, indicating an increase of temperature due to the vicinity of the same reservoirs of water. The line of 80° commences near Charleston, South Carolina, and extends rapidly upward through the valley of the Mississippi, thereby indicating that the temperature of summer in the interior, along this parallel, is much higher than on the seaboard. The western portion of this curve also exhibits great intensity of summer heat in the mountain system, and a remarkable degree of uniformity along the Coast range of mountains parallel to the Pacific. The short lines of 82°.5 and 85° denote a high temperature of uniform intensity, extending to the north, and indicate the great summer heat of the western plain.

It will be seen, by examining the blue lines, that the temperature of winter in the middle of the Mississippi valley, about the 95th meridian, is lower than on either the eastern or western coast; also, that the line of 30°, which is only two degrees above freezing, starts at the east end of Long Island, passes through Lake Erie, thence down to the 40th parallel, in longitude about 91°, and thence rapidly rises to the north, and leaves the United States at the 118th meridian. The line of 40° of winter temperature commences at the mouth of the Chesapeake, follows nearly the same general direction, and meets the Pacific ocean near Puget's Sound; indicating the remarkable fact that this place and Norfolk, on the Atlantic, have about the same winter temperature. The line of 50° is also similar to that of the last; also the line of 60°, which indicates in the Gulf of Mexico a lower degree of temperature in winter than exists on the Atlantic or Pacific coasts. In examining these winter lines attentively, it will be seen that the rise is not uniform from the 95th to the 105th degree, but the bend is most sudden about the 103d; which is probably caused by the occasional descent along this region of the polar winds to the Gulf of Mexico.

It has been stated that, in reducing the lines to the level of the sea, 333 feet of elevation have been taken for each degree of Fahrenheit's scale. Therefore, the actual temperature of any part of the United States may be readily determined, provided its elevation above the sea is known, by subtracting from the temperature given on the chart as many degrees as there are spaces of 333 feet in the elevation. Let us take, for example, the junction of the Kansas with the Missouri river, on the 95th meridian. This point, it will be seen by inspecting the map, is midway between the mean isothermal lines of 50° and 60°, and its temperature will therefore be approximately 55°. It has an elevation of about a

thousand feet, which will give three degrees for the reduction; and hence its temperature will be about 52°.

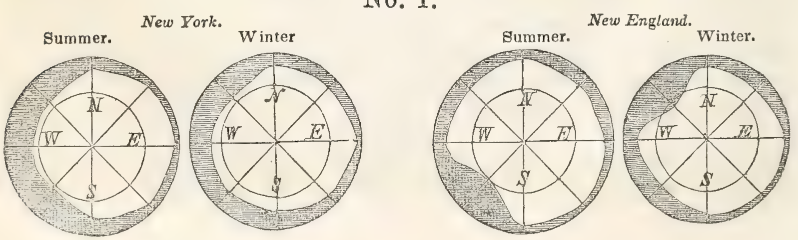
On a little reflection it will be clear that it would have been impossible to draw these lines on the uneven surface of the earth. The variation of temperature due to height would mask that due to latitude and other climatological causes. For example, a greater elevation of mountain peaks at the south would represent a colder local temperature than regions further north, would entirely hide from view the results which are due exclusively to the peculiarities of conformation of the country, and would give no means of comparison.

Winds of North America.—We have said that the whole mountain system of the western portion of the United States presents a remarkable abnormal elevation of temperature above the eastern and middle portion of the continent, and the question naturally presses itself upon us as to the cause of this surprising difference. The simple statement that the western side of Europe is also warmer than the eastern side of Asia does not explain the phenomenon; it merely points out an analogy, but not a cause. It is evident that the position of the mountain system, and the direction of the ridges with reference to the prevailing winds, must have some connection with this phenomenon. It will be well, therefore, before proceeding to this branch of the subject, to give a brief statement of some of the results which have been reached by deductions from actual observations in regard to this powerful agent in modifying climate. For the materials used for this purpose we shall be indebted to the valuable labors of Prof. Coffin, of Lafayette College, in connection with the Smithsonian Institution. In addition to this, the westerly aerial current, as it is principally derived from the equatorial regions, must in itself be warmer than the temperature due to the latitude of the belt in which it is moving.

In order that the facts may be the more readily comprehended, and produce a more indelible impression upon the mind, since ideas received through the eye are the most definite and lasting, we shall represent the direction and amount of the wind by means of diagrams such as are exhibited in the accompanying figures. The lines indicated by the letters N. E. S. W. represent the cardinal points of the compass, and the breadth of shading along any of these lines the relative amount of wind in the course of a given period observed at a particular place.

Thus, for example, in No. 1, in the circle on the right hand side,

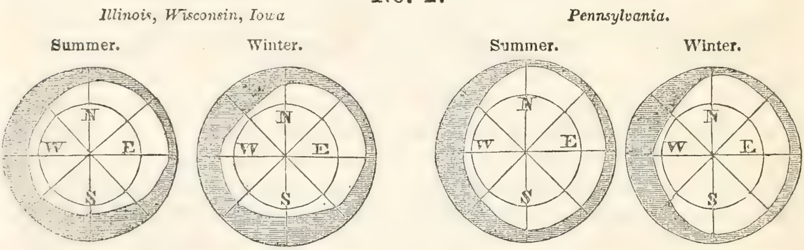
No. 1.



the shading represents the amount of wind from the different points of the horizon during the winter months in New England, from the average of a large number of observations at different places. Hence it will be seen that the predominant wind during the winter, in this part of the United States, is from the northwest; the next in amount is from the northeast and southwest, the eastern and southeastern portion of the horizon during the winter exhibiting but little wind. The next circle to the left shows the great preponderance of wind in New England from the southwest during the summer. The winds exhibited in the two circles combined will produce a general resultant from the west. The next circles to the left exhibit the amount of wind in summer and winter in the State of New York. In winter the greatest amount is from the northwest, and in summer from the southwest.

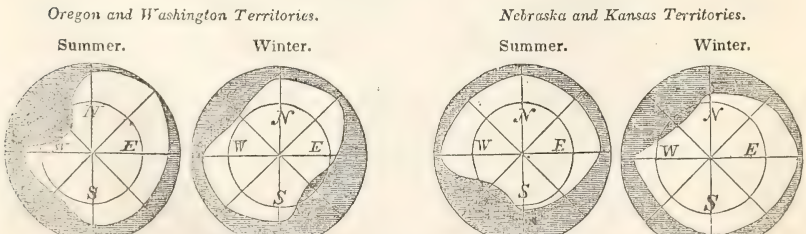
No. 2 represents the winds in Pennsylvania, Illinois, Wisconsin, and Iowa.

No. 2.



From these it will be seen that in Pennsylvania the wind is more westerly in winter than in New England, but still the greatest amount is from a point north of west. In summer the greatest amount is found a little south of west. During winter in the States of Illinois, Wisconsin, and Iowa, generally, the greatest prevalence is from the northwest, and in summer from the west and south. The maximum is a little east of south; the southwestern half, however, of the horizon in both seasons has the greatest amount.

No. 3.



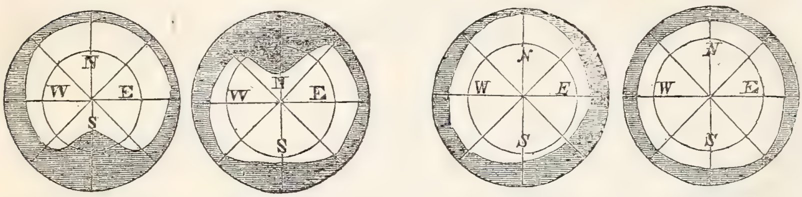
The circles in No. 3 indicate that in Nebraska and Kansas the greatest amount of wind in the winter is from the northwest, and

in the summer from the southwest. In Oregon and Washington Territories the greatest amount of wind in the winter is from the southeast, and the next greatest from the northwest, these two principally dividing the season between them. In summer a very large proportion is from the northwest, which is a remarkable inversion of the winds as observed in other parts of the United States. The principal current in winter being in the direction of the coast, from the southeast, consequently tends to mitigate the cold; while in summer it is in the opposite direction, and therefore tends to produce a similar effect in diminishing the intensity of the heat.

No. 4.

Texas and New Mexico. — *S. C., Ga., Ala., Miss.*

Summer. Winter. Summer. Winter.

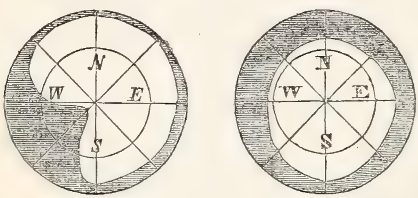


In No. 4 the two circles to the right exhibit the general direction of the wind in South Carolina, Georgia, Alabama, and Mississippi; and those on the left, in Texas and New Mexico. In the former the winds in winter nearly equally divide the whole circumference of the horizon; in summer the south and southeast winds prevail. In Texas and New Mexico the wind in winter is largely from the north, and often from the south; in summer its preponderance is greatly in favor of the south.

No. 5.

Lower California.

Summer. Winter.

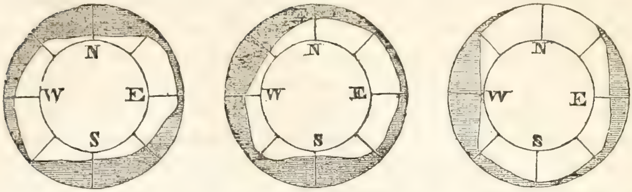


No. 5 exhibits the winds of Lower California, which in winter are from all parts of the horizon; those from the north and west, however, preponderating. In summer it is almost entirely from the southwest.

The winds thus represented are surface currents, and are consequently much influenced by the position of mountain ranges. This is strikingly shown in No. 6, which represents the mean annual wind at Hudson, Albany, and Utica, in the State of New York.

No. 6.

Hudson, N. Y. 8 years. | *Albany, N. Y.* 12 years. | *Utica, N. Y.* 12 years.



Hudson is in the valley of the Hudson river, a long, narrow glen extending in a north and south direction ; and, as the figure indicates, the winds are principally confined to the same course, blowing down the glen to the south in winter, and in the opposite direction in the summer. Albany is situated at the junction of the wide Mohawk valley with that of the Hudson, and the wind accordingly is from the northwest and from the south. Utica is in the valley of the Mohawk, which has a general east and west direction, the influence of which is strongly marked by the prevailing winds. In a like manner the direction of the wind on the coast of the Pacific is modified by the trend of the coast and the parallel mountain chains. Almost every position at which meteorological observations are made is liable thus to be affected by the local topography ; but the result of this is eliminated in a great measure by computing the average direction from a number of stations within a limited distance of each other. Yet, though in this way the opposite local influences in particular districts may be made to balance each other, those of great mountain systems still remain. These in turn, however, may be merged in a series of observations, extending across continents, or entirely around the world. In this way, by collecting all the reliable observations which have been made on the winds in the northern hemisphere, so far as they were accessible to the Smithsonian Institution, Prof. Coffin has established the fact, before mentioned, that the resultant motion of the surface atmosphere between latitude 32° and 58° in North America is from the west, the belt being twenty degrees wide, and the line of its greatest intensity in the latitude of about 45°. This, however, must oscillate north and south at different seasons of the year with the varying declination of the sun. South of this belt, in Georgia, Louisiana, &c., the country is influenced at certain periods of the year by the northeast trade winds, and north of the same belt by the polar winds, which, on account of the rotation of the earth, tend to take a direction toward the west. It must be recollected that the westerly direction of this belt here spoken of is principally the resultant of southwesterly and northwesterly winds alternately predominating during the year.

From what has been stated in regard to the general circulation of the atmosphere, it would appear that these winds are due to the returning upper currents which flow over from the heated region of the equator, producing a southwest, a west, or a northwest wind,

according to the distance to which they extend northward before they commence to descend to the earth. If the sun continued on the equator during the year, and there were no obstacles to the free motion of these currents, they would be constant in intensity and direction around the whole earth; but the change in declination of the sun, and the obstacles opposed by continents and mountain chains modify in an important degree the simplicity of this motion. When the sun ascends to the north, it carries with it the whole circulating system of the atmosphere, causes the northeast trade-winds to invade the southern part of the United States, and the inferior currents, which give rise to the southwest wind, to flow in summer over a large portion of our territory. The latter, charged with the vapor from the Atlantic and the Gulf of Mexico, impart warmth and fertility to all parts of the surface on which they descend. The higher currents, which produce the west and northwest winds, flow in summer above us, to descend further to the north. Their course, however, is marked by the almost invariable direction of the upper clouds and of the summer thunder storms, which, in the greater part of the United States, pass from the west to the east. The curving course of the returned currents, when the sun is south of the equator, is, perhaps, best marked by the direction of the hurricanes, which exactly follow the path we have described as that of the atoms of air in the general circulation so often referred to. This will be seen by examining the storm tracks on one of the maps of the lamented Redfield.

It is evident, from theory as well as from every day observation, that the currents of the belt of the northern hemisphere in which the United States is situated must be subject to many perturbing influences, and that this region is well entitled to the denomination of the zone of variable winds. While the great circulation which we have described is going on, particularly above us, every rain that occurs, and every variation of temperature, tends to disturb its regularity at the surface of the earth. According to the views here presented, the following winds of the United States belong to the general circulation, namely, the southwest, west, northwest, north, and northeast; while those from the opposite quarters of the horizon are principally due to abnormal atmospheric disturbances. We say principally, because a portion of the surface northeast trade wind in summer probably blows over Florida and the lower part of Louisiana. These views have been strengthened by a series of observations collected by M. De Doue, from which it is shown that the winds from the western half of the horizon, as indicated by the clouds, preponderate over those from the east, as indicated by the wind vane at the surface; or, in other words, that there is a greater tendency to a movement, even in our latitude, in the upper strata of air from the western half of the horizon, and in the lower from the eastern—a result in conformity with the general principles we have endeavored to explain. The circulation in the region of variable winds may often be inverted, and the compensation take place by means of winds in different parts of the hemisphere. It must be evident, from mechanical principles, that, to

balance every current of wind which flows to the north over any parallel of latitude along any meridian, an equal amount must flow back to the south either along that meridian or some other. If the compensation takes place at the same meridian, one current must flow above and the other below. If at different meridians, the compensating currents may both be at the surface or both above. The fact that very different temperatures prevail at different parts of the world at the same time under the same latitude favors the idea of Prof. Dove, that the compensation does in many cases take place in the latter way. Mr. Espy supposes that our southwest wind is produced mainly by the descent of the return trade winds at about the 30th parallel, and by rains accompanied with an elevation of temperature, and consequently an ascent of air, at the parallel of 58° or 60°, and that it returns again in an upper current, over the belt we have described, towards the south. That whatever air reaches the polar regions should descend there and flow southward, and then rapidly decline to the west, appears to be an evident consequence of well established laws. The rapid inclination of the air on account of the great increase of rotation in the surface of the earth in this latitude would tend to produce a wind in a westerly direction along the parallel of 60°, which would conflict with the currents from the south, and thus produce a low barometer, a tendency to rain, and form a natural boundary between what may be denominated the polar winds and the belt of westerly winds, due, as we have supposed, to the returning trades. The region of the middle belt must be one of great irregularity, occasionally encroached upon by the polar winds of the north on one side, and the intertropical winds of the south on the other, tending to restore the equilibrium in some cases in the mode suggested by Prof. Dove, and again in that proposed by Mr. Espy. We are, however, inclined to believe that all these are perturbations in the general circulation.

That the great western mountain system of North and Central America produces an important effect on these currents cannot be doubted, when it is recollected that one-third of the whole atmosphere is below its higher portions. It prevents the northeast trade wind from passing to the coast of the Pacific in about the latitude of 30°, and probably deflects northeastward a part of the lower portion of the upper return wind, giving more force and quantity to the southwest summer currents than they would otherwise have. This is the view adopted by Mr. Robert Russell, of Scotland, one of the most industrious and promising of the younger meteorologists of Europe, who visited this country about three years ago for investigating its climate and agriculture. It would appear, from what has been stated before, that a northwest current most generally prevails in the higher regions, and that the southwest current is a more superficial one. According to Mr. Russell, all the disturbances of the atmosphere in this country are produced by the unstable equilibrium occasioned by the superposition of the northwest wind on that of the southwest; and this, we think, in connection with the evolution of heat, according to the principles of Mr. Espy, will

account for all the violent commotions of our atmosphere, whether they appear in the form of winter storms, thunder gusts, or tornadoes. This subject, however, will be resumed in the next Report.

TERRESTRIAL OR UNDERGROUND CLIMATE.

An opinion has long prevailed that a climate cannot be changed to suit certain plants, but that the constitution of those plants may be so altered as to be adapted to a certain climate; and the process by which this effect is believed to be gained is called acclimatizing. But, notwithstanding this opinion, in most instances the truth is just the reverse, and the proposition should stand thus: "The constitution of plants, in general, cannot be altered to suit climate, yet climate may be altered to suit plants." When we limit the word "climate," however, to the conditions of the atmosphere in which birds and quadrupeds move, we express a particular state of things which concerns those parts of the creation, but we omit what is essential in considering the climate necessary to plants. And hence it is that, in the popular sense of the term "meteorology," cultivators derive less benefit from that science than it is capable of furnishing. The climate in which the roots of plants or trees are placed is at least as important, if not more so, to their successful growth, than that which sustains their branches, leaves, flowers, or fruits. It may with propriety be called "terrestrial," in contradistinction to "atmospheric" climate, and is one which it is in the power of almost any farmer or gardener to improve by artificial means.

The roots of plants, it is well known, although they burrow below the surface of the ground, are not on that account insensible to the influences which are felt by the stem and branches above. On the contrary, they are fully as sensitive to the extremes of moisture and dryness, or of heat and cold. Thus, if leaves and flowers wither beneath the scorching air, so do roots when the earth around them becomes parched; if the verdant foliage rejoices in the invigorating rain-drop, not less is it grateful to the earth-bound root; if cold checks or destroys the blossom and compels the foliage to shrink and perish, in like manner also the roots are affected. On the other hand, that warmth which causes the blossom to unfold, and the leaf to open to the influences of the gentle breath of spring, is equally propitious to the root under ground, exciting it to growth, and putting into action all that dynamic force by which the leaves and flowers are nourished. Nor is the access of air less important to one than to the other; both extremities of plants feed on air—the roots more than the leaves. Put a plant in a place where air can have no access to its leaves, and they fall, to be followed by the decay of the stem. Roots existing under the same circumstances will gradually shrink and die. Hence it is that the condition of the air which circulates in the ground, the temperature of the soil itself, and the moisture contained therein, require to be regulated, as well as that of the atmosphere above; and hence the

importance that underground climate should be thoroughly understood.

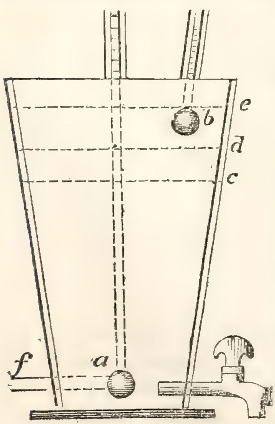
In order that a cultivator may not experience so much mysterious disappointment where he often expects the best success, he need only be told that his remedy lies alone in the perfect and skillful drainage of his soil. For, under-drained land is not merely wet, but "water-logged," all the interstices between the particles of earth being filled with water, and consequently destitute of air, except a small quantity which may be contained in the water. By this means, the plants are deprived of the most essential part of their food. But when the water is removed, air takes its place and holds in suspension sufficient moisture for the roots to subsist upon; for it is not water in a fluid state which plants in general prefer, but when it has assumed the state of air-borne vapor, the best of all food for roots.

But those who imagine that this is the whole explanation of the effects of drainage upon crops, overlook another circumstance of the highest importance: "Drained land, in summer, may be from 10° to 20° F. warmer than water-logged land." Hence it is evident that drainage produces the very important effect upon land of raising its temperature, communicating what gardeners call "bottom heat;" and those who are most conversant with plants know the value of this, as soil requires to be heated in some degree for all plants, but some kinds demand a higher temperature than others.

The reason why drained land requires an increased temperature, and water-logged land is always cold, consists in a well known fact, that heat cannot be transmitted downwards through water. This may readily be seen by the following experiments, which any one can repeat for himself.

Experiment No. I.

A box was made of the form represented by the annexed diagram, 18 inches deep, 11 inches wide at the top, and 6 inches wide at the bottom. It was filled to *c* with peat, saturated with cold water, forming a sort of artificial bog to the depth of 12½ inches. The box was then filled with cold water to *d*. A thermometer *a* was plunged so that its bulb was within 1½ inches of the bottom. The temperature of the whole mass of peat and water was found to be 39½° F. A gallon of boiling water was then added, which raised the surface of the water to *e*. In five minutes, the thermometer *a* indicated a temperature of 44°, owing to the conduction of heat by the tube of the thermometer and its guard. At ten minutes from the introduction of the hot water, the thermometer *a* showed a maximum tempera-



ture of 46°. Another thermometer *b* was then introduced, dipping under the surface of the water at *e*, and the following are the indications of the two thermometers at the respective intervals, reckoning from the time the hot water was supplied:

Time.	Thermometer *a*.	Thermometer *b*.
h. m.		
0 20	46°	150°
1 30	45	101
2 30	42	80½
12 40	40	45

The mean temperature of external air to which the box was exposed during the above period was 42°; the maximum being 47° and the minimum 37°.

Experiment No. II.

With the same arrangement as in the preceding case, a gallon of boiling water was introduced above the peat and water, when the thermometer *a* indicated a temperature of 36°. In ten minutes it rose to 40°. The cock was then turned for the purpose of drainage, which was slowly effected, and at the end of twenty minutes the thermometer *a* still indicated 40°; in twenty-five minutes 42°, while the thermometer *b* stood at 142°. In thirty minutes, the cock was withdrawn from the box, in order to afford a freer egress of the water. In thirty-five minutes, the flow of water was no longer continuous, at which time the thermometer *b* indicated 48°. The mass was now drained and permeable to a fresh supply of water. Accordingly another gallon of boiling water was poured over it, and the thermometer *a* indicated, at the respective intervals, reckoning from the time it was supplied, the temperatures as given in the table below:

Time.	Temperature.
h. m.	
0 3	The mercury rose to 77°
0 5	" " fell to 76½
0 15	" " " to 71
0 20	" " remained at 70½
1 50	" " " 70½

In these two experiments, the thermometer at the bottom of the box indicated a sudden rise of temperature immediately after the hot water was added; and hence it might be inferred that heat was conveyed downwards by the water. But in reality the rise was

owing to the action of the hot water upon the bulb and guard of the thermometer, and not to its action upon the cold water. To prove this, the perpendicular thermometers were removed. The box was filled with peat and water to within 3 inches of the top; a very delicate horizontal thermometer *a*, *f*, having been previously secured through a hole made in the side of the box by means of a tight-fitting cork, in which the naked stem of the instrument was grooved; a gallon of boiling water was then added, and the thermometer was not in the least affected by it as it was poured in at the top of the box.

The intelligent cultivator will at once see the application of these experiments. The wooden box is a field; the peat and cold water represent the water-logged portion; rain falls on the field and becomes warmed by contact with the surface soil, which may be, perhaps, of a temperature of 130°, and is thus heated, say 100°, and so descends into the earth, but is stopped by the cold water in the undrained land, and the heat will go no further. So that, if hot water were to be rained on a water-logged field for a month, the temperature of the soil would not be raised to the depth of a single inch below the surface where the cold water naturally stands. On the contrary, if the soil be open, and not water-logged, the warm rain descends through the crevices in the earth, carrying with it the high temperature it has gained at the surface, imparts it to the soil as it passes downward, and thus produces that bottom heat which is so essential to plants.

The nature of deep-draining, then, is, in fact, such as to change the underground climate by admitting an additional access of air and warm rain to the roots of plants too inconsiderable to be appreciable. It is only when deep draining and deep trenching accompany each other that much increased access of air to roots beyond what is customary can be anticipated. Where both are secured, the effect on vegetation will certainly appear like magic.

D. J. B.

COMMERCIAL STATISTICS.

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from Apalachicola, Florida, in the year ending December 31, 1856: *by* ROBERT J. FLOYD, *Collector of Customs.*

ARTICLES.	Amount conveyed coastwise.	Amount shipped to foreign ports.	Total amount.	Average prices.	Valuation.
Beeswax ....pounds..	1,500	....	1,500	$0 30	$450
Corn, shelled ....bushels..	11,550	....	11,550	60	6,930
Cotton................bales..	57,753	33,774	91,527	50 00	4,576,350
Hides ....number..	12,000	....	12,000	2 00	24,000
Lumber, pine...........feet..	51,900	70,069	121,969	1	1,220
Lumber, hemlock ....feet..	100,000	....	100,000	1	1,000
Otter skins..........number..	400	....	400	1 50	600
Peanuts.............bushels..	318	....	318	1 00	318
Rosin ....barrels..	9,308	6,077	15,385	1 00	15,385
Spirits of turpentine..gallons..	133,480	11,480	144,960	40	57,984
Staves ....number..	192,765	....	192,765	3	5,783
Staves ....thousand..	....	1,000	1,000	5 00	50,000
Tar and pitch ....barrels..	....	45	45	2 00	90
Tobacco, leaf ....pounds..	495,600	....	495,600	40	198,240
Total................	....	....	....	....	4,388,450

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from Baltimore, Maryland, in the year ending December 31, 1856: *by* PHILIP F. THOMAS, *Collector of Customs.*

ARTICLES.	Am't shipped to foreign ports.	Valuation.
Apples ....barrels..	623	$4,351
Bacon, in bulk ....pounds..	3,487,521	308,828
Bagging..................................	....	2,041
Bark, oak	....	68,622
Beans...................................bushels..	6,300	13,133
Beef, salt...............................barrels..	5,132	117,436
Beef, salt ....tierces..	19,050	

STATEMENT—Concluded.

Articles.	Am't shipped to foreign ports.	Valuation.
Beeswax ---- pounds--	45,791	$14,393
Buiscuit or shipbread ---- barrels or kegs--	35,547	114,982
Butter ---- pounds--	369,727	63,475
Candles ---- pounds--	786,831	126,904
Cheese ---- pounds--	131,859	16,428
Cider ----	----	761
Clover-seed, white ---- bushels--	888	7,060
Coal, anthracite ---- tons--	10,974	50,321
Cordage and cables ---- pounds--	101,360	9,095
Corn, shelled ---- bushels--	842,515	577,156
Corn-meal ---- barrels--	68,040	325,603
Cotton goods, printed or colored ---- yards--	2,372,000	195,828
Cotton goods, uncolored ---- yards--	1,672,000	79,403
Earthenware ----	----	1,432
Flour ---- barrels--	559,879	5,081,426
Hay ---- bales or tons--	96	555
Hogs, live ---- number--	2	36
Horses ---- number--	25	2,900
Implements, agricultural ----	----	18,292
Iron, castings ----	----	182
Lard ---- pounds--	1,754,699	317,704
Leather ---- pounds--	9,979	6,629
Lumber, pine ---- M. feet--	2,037	36,245
Oats ---- bushels--	2,673	1,340
Oil, lard ---- gallons--	8,618	7,180
Onions ----	----	4,106
Peas ---- bushels--	1,800	3,600
Pork ---- tierces and barrels--	18,225	306,626
Potatoes, sweet ---- bushels--	4,060	4,248
Rice ---- tierces--	2,972	100,096
Rosin ---- barrels--	19,619	31,598
Rum ---- gallons--	9,727	3,405
Rye ---- bushels--	22,373	39,381
Rye-meal ---- barrels--	5,019	25,619
Salt ---- bushels--	650	324
Sheep and lambs ---- number--	30	80
Spirits of turpentine ---- gallons--	15,096	8,519
Staves and heading ---- thousand--	1,424	54,529
Sugar, cane ---- pounds--	452,996	40,939
Tallow ---- pounds--	313,370	38,925
Tar and pitch ---- barrels--	3,153	6,976
Tobacco, leaf ---- pounds--	39,354,587	3,323,620
Tobacco, strips ---- pounds--	660,000	21,415
Tobacco, stems ----	----	95,273
Tobacco, chewing ---- pounds--	289,377	43,678
Vinegar ---- gallons--	17,772	3,437
Wheat ---- bushels--	1,550,264	1,709,097
Whiskey ---- gallons--	52,708	30,393
Total ----	----	13,462,625

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from Buffalo, New York, in the year ending December 31, 1856: *by*-JOHN T. HUDSON, *Collector of Customs.*

ARTICLES.	Number and quantity.	Valuation.
Apples ----barrels--	303	$817
Beef ----barrels--	187	3,077
Beer, ale, porter, and cider, in casks ----gallons--	3,966	860
Biscuit or shipbread----barrels--	60	303
Boards, planks, and scantling----M feet--	4,671	72,583
Boots and shoes----pairs---	13,856	29,120
Books and maps----	----	4,222
Bricks, lime, and cement----	----	660
Butter ----pounds--	7,919	1,755
Cables and cordage ----cwt---	12,758	4,023
Candles, adamantine and other----pounds--	20,286	2,226
Candles, spermaceti----pounds--	836	294
Carriages and parts, and railroad cars and parts----	----	3,933
Castings, iron----	----	16,815
Cheese ----pounds--	138,053	13,769
Clover-seed ----	----	889
Coal----tons---	1,433	8,037
Copper and brass, and manufactures of ----	----	2,530
Corn, Indian ----bushels--	203,528	134,685
Corn-meal ----barrels--	541	2,105
Cotton, printed or colored ----	----	4,792
Cotton, unprinted----	----	7,977
Drugs and medicines----	----	11,296
Earthen and stone-ware ----	----	2,336
Fish, dried or smoked----cwt---	379	1,295
Fish, pickled----barrels--	141	1,737
Flour ----barrels--	1,168	7,587
Furniture, household----	----	33,446
Hams and bacon ----pounds--	95,623	9,665
Hats, fur or silk----	----	2,399
Hemp----cwt---	33	469
Hemp, rags and other manufactures of----	----	885
Hides ----number--	412	2,000
Hops ----pounds--	2,600	270
Horned cattle ----number--	36	1,395
Horses ----number--	44	3,639
Iron, pig ----cwt---	4,520	4,161
Iron, all other manufactures of----	----	163,208
Jewelry, real and factitious ----	----	336
Lard ----pounds--	13,534	1,365
Leather and manufactures of----pounds--	25,328	5,129
Lead ----pounds--	2,200	225
Marble and stone, manufactures of----	----	13,694
Molasses ----gallons--	5,650	3,532
Musical instruments ----	----	5,708
Nails ----pounds--	46,980	2,390
Oak-bark, and other dye----	----	1,441
Oil, linseed ----gallons--	2,471	2,500
Oil, whale and other fish ----gallons--	10,177	10,280
Paints and varnish----	----	1,393
Paper and other stationery----	----	2,513
Planks and scantling ----M feet--	96	1,835
Pork ----barrels--	1,594	31,169

STATEMENT—Concluded.

ARTICLES.		Number and quantity.	Valuation.
Potatoes	barrels	1,102	$1,281
Printing presses and type			606
Rice	tierces	59	1,501
Rye, oats, &c			53,955
Saddlery			1,944
Salt	bushels	18,025	7,569
Skins and furs			2,686
Snuff	pounds	300	75
Soap	pounds	31,550	1,713
Spirits from grain	gallons	25,440	7,479
Spirits of turpentine	gallons	825	558
Staves and heading	thousand	132	2,586
Sugar, brown	pounds	29,961	2,803
Sugar, refined	pounds	74,460	7,196
Tallow	pounds	89,579	6,073
Tar and pitch	barrels	106	496
Timber, hewn	tons	1,518	7,185
Tin			515
Tobacco, manufactured	pounds	34,172	6,958
Trunks and valises			226
Vinegar	gallons	2,521	369
Wearing apparel			2,743
Wheat	bushels	42,617	51,051
Wood, manufactures of			30,805
All other articles manufactured			9,650
All other articles raw			3,597
Total			856,390

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from Cape Vincent, New York, in the year ending December 31, 1856: *by* Alfred Fox, *Collector of Customs.*

ARTICLES.		Am't conveyed coastward by river.	Amount conveyed inland.	Amount shipped to foreign ports.	Total amount.	Average price.	Valuation.
Alcohol	gallons	4,890		3,360	8,250	$0 63	$5,198
Apples	barrels	2	11	60	73	3 00	219
Apples, dried	pounds	4,724			4,724	8	378
Barley	bushels	17,500	33,662		51,162	1 00	51,162
Beans	bushels		40		40	2 00	80
Beef, salt	barrels	1		27	28	10 00	280
Brooms	number	1,375			1,375	18	248
Butter	pounds	7,831	131,536		139,367	20	27,873
Candles	pounds	420	26,321		26,741	25	6,685
Cheese	pounds		18,030	27,080	45,110	10	4,511

STATEMENT—CONCLUDED.

ARTICLES.	Am't conveyed coastward by river.	Amount conveyed inland.	Amount shipped to foreign ports.	Total amount.	Average price.	Valuation.
Cordage ....pounds..	7,837	....	20,400	28,237	$0 12	$3,387
Corn, shelled....bushels..	....	77,853	....	77,853	60	46,712
Corn-meal.......barrels..	....	....	334	334	5 00	1,670
Cotton, prints	....	....	....	....	....	57,916
Cotton, uncolored.......	....	....	....	....	....	32,793
Flour............barrels..	999	1,388	2,041	4,428	7 00	30,996
Hickory nuts ... bushels..	....	60	....	60	2 00	120
Hides ....number..	....	30,083	....	30,083	4 00	120,332
Iron, pig........pounds..	4,145,000	....	59,000	4,204,000	1	42,040
Iron, bar........pounds..	5,445	....	8,800	14,245	5	712
Iron, castings....pounds..	....	....	....	5,445	3	163
Lard ....pounds..	....	14,846	11,231	26,077	14	3,651
Lead pipe........pounds..	2,544	....	....	2,544	10	254
Leather............rolls..	150	....	....	150	30	45
Lumber, pine.......feet..	71,166	....	....	71,166	M 12 00	8,540
Molasses.........gallons..	282	....	44,251	44,533	50	22,267
Oil, linseed.......gallons..	220	....	10,515	10,735	75	8,051
Oysters ....gallons..	....	....	700	700	1 25	875
Pelts, sheep, &c..number..	....	3,649	....	3,649	1 00	3,649
Pork ....barrels..	83	466	263	812	20	16,240
Potatoes, common, bushels.	130	....	....	130	38	49
Rags, paper.....pounds..	3,370	20,770	....	24,140	3	724
Rice ....tierces..	2	....	229	231	....	10,810
Rosin...........barrels..	....	....	714	714	4 00	2,856
Rye............bushels..	....	2,495	....	2,495	75	1,871
Spirits of turpentine, gals..	220	....	3,677	3,897	50	1,949
Staves & heading, number..	....	....	....	....	....	24,832
Tallow ....pounds..	....	....	6,123	6,123	14	857
Tar and pitch....barrels..	....	....	312	312	2 00	624
Tobacco, chewing, pounds..	9,241	....	233,899	243,140	....	48,611
Wheat ....bushels..	....	59,864	....	59,864	1 25	74,810
Wool ....pounds..	....	14,109	....	14,109	25	3,527
Total	....	....	....	....	....	668,567

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from Chicago, Illinois, in the year ending December 31, 1856 : *by* PHILIP CONLEY, *Collector of Customs.*

ARTICLES.	Number and quantity.	Valuation.
Beef..barrels..	62	$709
Butter......................................pounds..	6,732	1,237
Cheese ....pounds..	1,075	154
Corn, Indian..............................bushels..	498,553	201,251

STATEMENT—Concluded.

ARTICLES.		Number and quantity.	Valuation.
Flour	barrels	12,028	$84,294
Hams and bacon	pounds	1,019,761	62,408
Hides	number	225	517
Hogs	number	152	199
Iron, manufactures of			752
Lard	pounds	649,499	55,079
Lead	pounds	61,936	5,196
Molasses	gallons	43	25
Oil, lard	gallons	1,064	913
Pork	barrels	15,884	235,200
Rice	tierces	2	35
Rye, oats, and other small grain and pulse			18,860
Salt	bushels	12	6
Sheep	number	25	76
Soap	pounds	40	3
Spirits from grain	gallons	6,489	1,521
Sugar, brown	pounds	1,100	107
Tallow	pounds	644,184	80,622
Vinegar	gallons	40	6
Wheat	bushels	657,673	748,578
All other articles raw			2,182
Total			1,499,930

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from Detroit, Michigan, in the year ending December 31, 1856 *: by* John H. Harmon, *Collector of Customs.*

ARTICLES.		Am'nt exported coastward.	Am'nt shipped to foreign ports.	Total amount.	Average prices.	Valuation.
Apples	barrels	525	10	535	$3 00	$1,605
Ashes, pot	tons	125		125	18 00	2,250
Barley	bushels	6,550	2,250	8,800	1 00	8,800
Beans	bushels	1,000		1,000	50	500
Beef, salt	barrels	3,700	772	4,472	10 00	44,720
Buckwheat	bushels	1,000		1,000	1 00	1,000
Butter	pounds	1,500		1,500	20	300
Calves	number	1,200		1,200	4 00	4,800
Candles	pounds	5,225	5,310	10,535	10	1,053
Carpets	yards	250	550	800	1 00	800
Cattle	number	13,525		13,525	30 00	405,750
Cedar posts	number	3,641		3,641	10	364
Cedar rails	number	1,520		1,520	10	152
Cheese	pounds	15,100	4,300	19,400	10	1,940
Cider	barrels	5,000		5,000	2 50	12,500
Coal, bituminous	tons	1,250	890	2,140	5 50	11,770
Copper, ore	tons	2,125		2,125	20 00	42,500

STATEMENT—Concluded.

Articles.		Am'nt exported coastward.	Am'nt shipped to foreign ports.	Total amount.	Average prices.	Valuation.
Copper, sheet	pounds	500		500	$0 30	$150
Cordage and cables	pounds	1,050		1,050	6	63
Corn, shelled	bushels	138,340	150,652	288,992	50	144,496
Corn-meal	barrels		2	2	4 00	8
Cotton, piece goods	pieces	3,153	3,870	7,023	5 00	35,115
Earthenware						2,655
Feathers	pounds	1,600		1,600	37½	600
Flannel, woolen	yards	200	1,353	1,553	25	388
Flour	barrels	268,061	16,900	284,961	6 00	1,709,766
Hay	bales or tons.	2,000		2,000	10 00	20,000
Hides	number	33,835	1,500	35,335	1 50	53,002
Hogs, live	number	14,734	1,750	16,484	10 00	164,840
Hoops	thousand	93,150		93,150	2 00	186,300
Implements, agric'l						2,165
Iron, pig	pounds	28,785		28,785	1¼	360
Iron, bar	pounds	110,272		110,272	2	2,205
Iron, castings	tons	1,565		1,565	40 00	62,600
Lard	pounds	1,325	722	2,047	10	205
Lead, bar	pounds	1,000	175	1,175	6	71
Leather	rolls	250	125	375	10 00	3,750
Lime	barrels	4,500	1,020	5,520	3 00	16,560
Lumber, pine	M feet	125,650	62,000	187,650	10 00	1,876,500
Lumber, oak	M feet	16,255	5,000	21,255	8 00	170,040
Lumber, blk. walnut	M feet	12,550	2,000	14,550	20 00	291,000
Marble, quarried	tons	125	10	135	60 00	8,100
Molasses	gallons		1,745	1,745	50	872
Oats	bushels	75,743		75,743	37½	28,404
Oil, lard	gallons	102,750		102,750	1 00	102,750
Oil, linseed	gallons	38,100	2,483	40,583	1 00	40,583
Onions	bushels	1,000		1,000	50	500
Oranges	number		1,250	1,250	3	37
Peas	bushels	250		250	30	75
Pelts, sheep or lambs'	number	5,000		5,000	25	1,250
Pork	tcs. and bbls.	1,550	1,000	2,550	20 00	5,100
Potatoes, common	bushels	10,125	50	10,175	50	5,087
Rags, paper	pounds	12,523,560		12,523,560	2	250,471
Rosin	barrels	250	66	316	2 00	632
Salt	bushels	122,221	57,355	179,576	50	89,788
Sheep and lambs	number	15,250		15,250	3 00	45,750
Shot	pounds	1,000		1,000	5	50
Snuff	pounds		704	704	20	141
Staves and heading	thousand	124,146	8,000	132,146	30 00	3,964,380
Sugar, cane	pounds		69,510	69,510	6	4,171
Tallow	pounds		186	186	10	19
Tar and pitch	barrels	256	166	422	4 00	1,688
Timothy-seed	bushels	120	100	220	5 00	1,100
Tobacco, chewing	pounds		1,500	1,500	30	450
Vinegar	gallons	221	25	246	25	61
Wheat	bushels	857,571	165,000	1,022,571	1 00	1,022,571
Whiskey	gallons	184,050	108,255	292,305	30	87,691
Wool	pounds	308,190		308,190	20	61,638
Total						11,007,002

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from Elizabeth City, North Carolina, in the year ending December 31, 1856 : *by* L. D. STARKE, *Collector of Customs.*

ARTICLES.	Am't shipped to foreign ports.	Average prices.	Valuation.
Corn, shelled.....bushels..	652	$0 55½	$361 86
Geese.....number..	292	50	146 00
Shooks.....number..	2,000	1 00	2,000 00
Shingles.....thousand..	5,687	3 38	19,224 06
Staves and heading.....thousand..	465	.....	9,397 65
Total.....	.....	.....	31,129 57

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from Franklin, Louisiana, in the year ending December 31, 1856 : *by* R. W. MCMILLAN, *Collector of Customs.*

ARTICLES.	Am't conveyed coastward.	Average prices.	Valuation.
Lumber, cypress.....feet..	4,000	$0 03	$120 00
Lumber, live-oak.....cubic feet..	48,500	30	14,550 00
Molasses.....gallons..	770,480	10	77,048 00
Moss, Spanish.....pounds..	46,400	2	928 00
Oranges.....number..	5,000	1½	75 00
Sugar, cane.....pounds..	13,727,714	3½	480,469 99
Total.....	.....	.....	573,190 99

NOTE.—The collector expresses the opinion that the "exports inland, by river steamboats and railroad," would equal in value those exported by sea.

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from Galveston, Texas, in the year ending December 31, 1856 : *by* HAMILTON STUART, *Collector of Customs.*

ARTICLES.	Number and quantity.	Valuation.
Cotton, Sea Island.....bales..	33,457	$1,476,984
Cotton, other.....pounds..	16,039,461	
Hides.....number..	604	1,853
Skins and furs.....	.....	682
Tallow.....pounds..	2,744	306
All other articles raw.....	.....	200
Total.....	.....	1,480,025

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from Gardiner, district of Cape Perpetua, Oregon, in the year ending December 31, 1856: *by* ADDISON C. GIBBS, *Collector of Customs.*

ARTICLES.	Am't conveyed coastward by river.	Average prices.	Valuation.
Bacon, in bulk pounds	6,000	$0 14	$840
Fowls, common number	480	25	120
Leather rolls	100	10 00	1,000
Lumber, fir M feet	600	12 00	7,200
Masts and spars feet	15,000	8	1,200
Potatoes bushels	200	1 00	200
Wood, fir cords	120	3 50	420
Total			10,980

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from Georgetown, District of Columbia, in the year ending December 31, 1856: *by* ROBERT WHITE, *Collector of Customs.*

ARTICLES.	Amount conveyed coastward.	Amount shipped to foreign ports.	Total amount.	Average prices.	Valuation.
Coal, bituminous tons	50,000		50,000	$3 50	$175,000
Corn-meal barrels	278	725	1,003	3 00	3,009
Cotton goods pieces	20,084		20,084	3 00	60,252
Flour barrels	218,087	2,258	220,345	7 00	1,542,415
Lime barrels	20,000		20,000	1 00	20,000
Lumber, pine M feet		146	146	17 00	2,482
Total					1,803,158

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from Great Egg Harbor, New Jersey, in the year ending December 31, 1856 : *by* THOMAS D. WINNER, *Collector of Customs.*

ARTICLES.	Am't conveyed coastwise.	Average prices.	Valuation.
Cedar rails.................number..	40,000	$0 06	$2,400
Charcoal.................bushels..	302,400	7	21,168
Clams...........................	....	....	30,000
Hoop-poles.................number..	1,200,000	1⅕	14,400
Iron, castings.................tons..	12,000	40 00	480,000
Lumber, pine.................feet..	3,528,000	1⅖	49,392
Oysters.................bushels..	40,000	1 00	40,000
Wood, hard.................cords..	4,000	3 00	12,000
Wood, pine.................cords..	12,000	2 50	30,000
Total...........................	....	....	679,360

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from Jacksonville, Florida, in the year ending December 31, 1856 : *by* JAMES G. DELL, *Collector of Customs.*

ARTICLES.	Number and quantity.	Valuation.
Biscuit or shipbread.................barrels..	6	....
Boards, plank, and scantling.................M feet..	32,726	$395,210
Fish, dried or smoked.................cwt...	10	33
Furniture, household...........................	....	803
Potatoes.................barrels..	30	....
Soap.................pounds..	3,000	286
Tobacco.................hogsheads..	10	1,967
Total...........................	....	398,299

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from Key West, Florida, in the year ending December 31, 1856: *by* JOHN P. BALDWIN, *Collector of Customs.*

ARTICLES.	Am't conveyed coastwise.	Am't conveyed inland.	Am't shipped to foreign ports.	Total amount.	Average prices.	Valuation.
Arrow-root..........pounds..	18,500			18,500	$0 11	$2,035 00
Axes ....dozen..	70			70	7 00	490 00
Bagging ....pieces..	600			600	3 00	1,800 00
Bananas ....bunches..	200			200	50	100 00
Bones ....pounds..	8,800			8,800	3	264 00
Brooms ....dozen..			12	12	2 00	24 00
Butter ....firkins..			6	6	20 00	120 00
Coco-nuts ....number..	8,000			8,000	5	400 00
Coal, anthracite ......tons..	158			158	6 00	948 00
Cordage and cables...pounds..	24,750		5,000	29,750	10	2,975 00
Cotton......bales or pounds..	3,912			3,912	35 00	136,920 00
Cotton, Sea Island.....bales..	573			573	80 00	45,840 00
Cotton, piece goods....pieces..	3,000			3,000	2 00	6,000 00
Cotton goods, printed or colored ....yards..	3,250			3,250	1 50	4,875 00
Cotton canvas ......number..			9	9	22 50	202 50
Deer skins..........number..	807			807	25	201,75
Fish................barrels..	61			61	5 00	305 00
Fish, salted, (dry)......tons..			175	175	120 00	21,000 00
Fish, live..............tons..			150	150	200 00	30,000 00
Flour..............barrels..	$83\frac{1}{2}$		175	$258\frac{1}{2}$	7 00	1,809 50
Hay..........bales or tons..	115			115	3 50	402 50
Hemp, Sisal..........pounds..	11,000			11,000	10	1,100 00
Hides..............number..	1,750			1,750	1 00	1,750 00
Horns ....number..	1,550			1,550		23 25
Lard ....pounds..			250	250	11	27 50
Lemons..............barrels..	257			257	3 50	899 50
Lime ....barrels..	1,213			1,213	1 00	1,213 00
Lumber, pine..........feet..	10,000		12,500	22,500		247 50
Molasses............gallons..	28,000			28,000	30	8,400 00
Nails ....kegs..	238			238	3 00	714 00
Onions ....bushels..	60			60	1 00	60 00
Paint, mineral........pounds..		600		600	8	48 00
Pork......tierces and barrels..			4	4	30 00	120 00
Potatoes, common ...bushels..	972			972	1 00	972 00
Rags, paper ....pounds..	63,472			63,472	3	1,904 16
Rice ....tierces..			30	30	20 00	600 00
Saddlery..............cases..	22			22	50 00	1,100 00
Salt................bushels..	20,000			20,000	30	6,000 00
Satinet ....pieces..	500			500	3 00	1,500 00
Shoes ....cases..	100			100	20 00	2,000 00
Sails, suits, cotton...number..			4	4	400 00	1,600 00
Soap ....boxes..			28	28	5 00	140 00
Sponge ....pounds..	54,535			54,535	50	27,267 50
Staves and heading, thousand..	8,500			8,500	20 00	170 00
Sugar, cane ....pounds..	34,000			34,000	5	1,700 00

STATEMENT—CONCLUDED.

ARTICLES.	Am't conveyed coastwise.	Am't conveyed inland.	Am't shipped to foreign ports.	Total amount.	Average prices.	Valuation.
Tallow.............pounds..	2,400	......	....	2,400	$0 10	$240 00
Tobacco, chewing....pounds..	41,640	......	....	41,640	10	4,164 00
Turtles............number..	750	......	....	750	5 00	3,750 00
Turtle-shell.........pounds..	289	......	....	289	5 00	1,445 00
Twine..............pounds..	393	......	....	393	20	78 60
Whiskey............gallons..	420	......	240	660	30	198 00
Wood, hard..........cords..	127	......	....	127	50	63 50
Total..............	....	......	....	....	....	326,207 76

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from Lewiston, New York, in the year ending December 31, 1856: *by* AV. E. HOTCHKISS, *Collector of Customs.*

ARTICLES.	Number and quantity.	Valuation.
Apples...............barrels..	2,926	$4,373
Beef...............tierces..	17	1,246
Beef...............barrels..	44	
Beer, ale, porter, and cider, in casks.........gallons..	14,526	2,103
Billiard tables and apparatus............	....	12
Boards, planks, and scantling..........M feet..	55	1,697
Books and maps............	....	44,777
Boots and shoes...............pairs...	49,569	50,229
Bricks, lime, and cement............	....	1,309
Butter...............pounds..	57,344	10,599
Cables and cordage...............cwt...	244	4,139
Candles, adamantine and others..........pounds..	8,032	1,104
Carriages and parts, and railroad cars and parts..........	....	16,674
Cheese...............pounds..	258,939	27,639
Chocolate...............pounds..	50	21
Clover-seed............	....	796
Coal...............tons...	39	231
Combs and buttons............	....	5
Copper and brass, manufactures of............	....	2,604
Corn, Indian...............bushels..	5,186	3,220
Corn-meal...............barrels..	215	720
Cotton, printed or colored............	....	10,427
Cotton, white, other than duck............	....	8,433
Cotton duck............	....	200
Cotton, other manufactures of............	....	18,343
Drugs and medicines............	....	7,341
Earthen and stone-ware............	....	765
Fire-engines............	....	94

STATEMENT—Continued.

Articles.	Number and quantity.	Valuation.
Fish, dried or smoked............cwt...	151	$773
Fish, pickled............barrels...	27	142
Flour............barrels...	140	990
Furniture, household............	....	6,799
Glass............	....	9,861
Gunpowder............pounds...	1,450	290
Hams and bacon............pounds...	172,004	15,595
Hats, fur or silk............	....	25,251
Hemp............cwt...	144	1,356
Hemp, bags and other manufactures of............	....	676
Hides............number...	7,401	732
Hogs............number...	4	30
Hops............pounds...	13,800	2,741
Horned cattle............number...	470	19,693
Horses............number...	654	31,836
India-rubber, other manufactures of than shoes............	....	1,012
Iron, bar............cwt...	402	8,694
Iron, castings............	....	4,170
Iron, all other manufactures of............	....	292,646
Jewelry, real and factitious............	....	3,069
Lard............pounds...	14,826	1,613
Leather............pounds...	39,787	26,336
Lead............pounds...	8,731	1,652
Lumber............	....	265
Marble and stone, manufactures of............	....	9,957
Molasses............gallons...	9,869	3,924
Morocco and other leather not sold by the pound............	....	278
Musical instruments............	....	15,829
Nails............pounds...	53,620	1,629
Oil, linseed............gallons...	90	90
Oil, whale and other fish............gallons...	49,743	47,545
Onions............	....	86
Paints and varnish............	....	8,599
Paper and other stationery............	....	14,898
Pewter and lead, manufactures of............	....	863
Pork............barrels...	647	12,850
Potatoes............barrels...	3,559	3,806
Printing presses and type............	....	5,980
Rice............tierces...	14	445
Rosin and turpentine............barrels...	73	643
Rye-meal............barrels...	16	80
Rye, oats, and other small grain and pulse............	....	5,135
Saddlery............	....	426
Salt............bushels...	819	240
Sheep............number...	1,076	5,422
Shingles............thousand...	8	17
Skins and furs............	....	4,990
Soap............pounds...	17,342	1,047
Spirits from grain............gallons...	166,070	52,795
Spirits from other materials............gallons...	2,335	1,470
Sugar, brown............pounds...	154,742	15,990
Tallow............pounds...	244,724	22,972
Tar and pitch............barrels...	118	454
Timber, hewn............tons...	413	2,238
Tobacco, manufactures of............pounds...	115,408	32,558
Tobacco............hogsheads...	6	3,130
Tobacco............bales...	5	
Trunks and valises............	....	5,490

STATEMENT—CONCLUDED.

ARTICLES.	Number and quantity.	Valuation.
Turpentine, spirits of ....gallons..	3,768	$3,561
Vinegar ....gallons..	240	24
Wax ....pounds..	360	90
Wearing apparel........	....	5,981
Wheat ....bushels..	50	75
Wood, manufactures of........	....	43,581
Wool ....pounds..	300	90
All other articles manufactured........	....	79,706
All other articles raw........	....	47,999
Total........	....	1,138,306

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from Marblehead, Massachusetts, in the year ending December 31, 1856: *by* WILLIAM BARTOLL, *Collector of Customs.*

ARTICLES.	Amount conveyed coast-wise by sea.	Amount conveyed coast-wise by railroad or by land.	Amount conveyed inland.	Amount shipped to foreign ports.	Total amount.	Average prices.	Valuation.
Chairs........number..	....	....	....	12	12	$0 75	$9
Codfish, salt, (dry)......quintals..	46,532	....	....	....	46,532	3 50	162,125
Codliver oil........gallons..	....	....	16,944	....	16,944	81	13,725
Cordage and cables........pounds..	....	1,470,718	....	....	1,470,718	12	176,486
Corn, shelled .... bags..	....	....	....	104	104	2 00	208
Flour ....barrels..	....	....	....	424	424	8 00	3,392
Total........	....	....	....	....	....	....	355,945

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from Milwaukie, Wisconsin, in the year ending December 31, 1856 : *by* CARL OLSON, *Deputy Collector of Customs.*

ARTICLES.	Amount conveyed coastward by lake.	Amount shipped to foreign ports.	Total amount.	Average prices.	Valuation.
Ashes, pearl .... tons..	100	....	100	$100 00	$10,000
Bacon, hams..hhds. and tierces..	580	....	580	30 00	17,400
Bacon, in bulk .... pounds..	300,000	....	300,000	8	24,000
Barley .... bushels..	20,400	....	20,400	1 00	20,400
Beans .... bushels..	660	....	660	1 75	1,155
Beef, salt .... barrels..	5,200	....	5,200	10 00	52,000
Bricks, common .... number..	560,000	....	560,000	M 7 00	3,920
Cranberries .... bushels..	1,400	....	1,400	2 00	2,800
Flour .... barrels..	200,000	15,000	215,000	6 00	1,290,000
Hides .... number..	25,550	....	25,550	5 00	127,750
Hogs, live .... number..	1,000	....	1,000	5 00	5,000
Hops .... pounds..	50,000	....	50,000	15	7,500
Iron, pig .... pounds..	448,000	....	448,000	2	8,960
Lard .... kegs..	6,000	....	6,000	10 00	60,000
Lime .... barrels..	546	....	546	2 00	1,092
Oats .... bushels..	14,000	....	14,000	35	4,900
Pelts, sheep or lambs' ..number..	26,305	....	26,305	25	6,576
Pork .... tierces and barrels..	12,000	....	12,000	12 00	144,000
Staves and heading ..... number..	800,000	....	800,000	2	16,000
Timothy-seed .... bushels..	10,300	....	10,300	5 00	51,500
Vinegar .... gallons..	21,000	....	21,000	10	2,100
Wheat .... bushels..	3,097,000	80,000	3,177,000	1 00	3,177,000
Whiskey .... gallons..	320,000	....	320,000	35	112,000
Wool .... pounds..	850,000	....	850,000	30	255,000
Total	....	....	....	....	5,401,053

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from Mobile, Alabama, in the year ending Dec. 31, 1856: *by* T. SANFORD, *Collector of Customs.*

ARTICLES.		Am't conveyed coastwise.	Amount shipped to foreign ports.	Total amount.	Average prices.		Valuation.
Bricks, common	number	4,000,000		4,000,000	M	$8 00	$32,000
Cotton	bales	130,709	426,534	557,243	lb.	9½	26,077,903
Hides	number	23,630		23,630		2 50	59,075
Lumber, pine	feet	1,900,000	6,284,000	8,184,000		1	81,840
Lumber, hewn	tons		1,369	1,369		7 00	9,583
Masts and spars	number		2,158	2,158			172,640
Oysters	bushels	40,000		40,000		1 00	40,000
Oysters	gallons	8,000		8,000		2 00	16,000
Rosin	barrels	10,838	3,000	13,838		1 75	24,216
Spirits of turpentine	gallons	20,000		20,000		50	10,000
Staves	thousand	143	175	318		50 00	15,900
Tallow	pounds		10,000	10,000		10	1,000
Tar and pitch	barrels	2,000		2,000		1 50	3,000
Total							26,543,157

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from Monterey, Texas, in the year ending December 31, 1856: *by* JAMES A. WATSON, *Collector of Customs.*

ARTICLES.		Am't conveyed coastward by river.	Am't conveyed inland.	Average prices.	Valuation.
Barley	bushels	56,158		$0 75	$42,118
Beans	bushels	22,549		3 00	67,647
Butter	pounds	20,000		40	8,000
Cattle	number		5,500	20 00	110,000
Eggs	dozen	3,120		50	1,560
Flour	barrels	2,500		11 00	27,500
Fowls, common	number	3,168		75	2,376
Hides	number	1,200		2 00	2,400
Hogs, live	number	1,750		10 00	17,500
Horses	number		350	40 00	14,000
Leather	pounds	34,175		40	13,670
Lumber, pine	M. feet	600		20 00	12,000
Onions	bushels	242		2 25	544
Peas	bushels	381		4 00	1,524
Potatoes, common	bushels	62,508		1 00	62,508
Sheep and lambs	number		4,800	3 00	14,400
Wheat	bushels	8,158		2 00	16,316
Wood, pine	cords	10,400		4 00	41,600
Wool	pounds	75,000		6	4,500
Total					460,163

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from New Bedford, Massachusetts, in the year ending December 31, 1856: *by* C. B. H. FESSENDEN, *Collector of Customs.*

ARTICLES.	Amount shipped to foreign ports.	Valuation.
Apples ... barrels	10	$33
Beans ... bushels	85	102
Bricks, common ... number	6,000	48
Butter ... pounds	1,348	263
Cheese ... pounds	2,364	202
Corn, shelled ... bushels	1,400	800
Cotton ... bales	1	70
Cotton goods, printed or colored ... yards	2,927	205
Cotton goods, uncolored ... yards	8,274	646
Cotton, yarn ... pounds	3,371	674
Flour ... barrels	122	810
Hoops ... thousand	49	1,374
Hops ... pounds	100	10
Horses	...	261
Iron, castings	...	1,143
Lard	...	700
Lumber, pine ... feet	54,000	1,020
Onions ... bushels	228	144
Paint, mineral ... pounds	1,353	102
Pork ... tierces and barrels	16	300
Potatoes, common ... bushels	125	127
Rice ... tierces	18	797
Shooks ... thousand	4	8,075
Tallow ... pounds	1,100	120
Tar and pitch ... barrels	50	120
Total	...	18,146

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from New Haven, Connecticut, in the year ending December 31, 1856: *by* N. WILCOX, *Deputy Collector of Customs.*

ARTICLES.	Amount shipped to foreign ports.	Average prices.	Valuation.
Apples ... barrels	15	$3 00	$45
Bacon, in bulk ... pounds	28,740	...	3,430
Beans ... bushels	7,741	1 00	7,741
Beef, salt ... barrels	208	11 50	2,392
Biscuit or ship-bread ... barrels or kegs	3,112	3 40	10,581
Butter ... pounds	15,803	21	3,319
Candles ... pounds	143,080	17	24,324
Cattle ... number	2	50 00	100
Cheese ... pounds	94,593	12	11,351
Corn, shelled ... bushels	600	79	474
Corn-meal ... barrels	21,053	3 75	78,949
Flour ... barrels	5,010	7 25	36,322
Hoops ... number	800,000	2	16,000

STATEMENT—Concluded.

ARTICLES.	Amount shipped to foreign ports.	Average prices.	Valuation.
Horses ....number..	536	$85 90	$45,042
Lard ....pounds..	118,897	$12\frac{3}{4}$	15,159
Mules........................number..	1,141	104 00	118,664
Onions ....bushels..	1,972	50	986
Peas ....bushels..	7,741	1 00	7,741
Pork...............tierces and barrels..	2,700	18 00	48,600
Potatoes, common...............bushels..	7,254	65	4,715
Rice ....tierces..	271	26 27	7,120
Rosin ....barrels..	150	3 00	450
Sheep and lambs...............number..	15	5 50	82
Shooks........................number..	35,543	1 65	58,646
Spirits of turpentine...........gallons..	593	49	289
Tar and pitch...................barrels..	20	2 48	50
Tobacco, leaf.................hogsheads..	22	199 00	4,388
Tobacco, chewing...............pounds..	21,934	12	2,632
Total	....	....	509,592

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from New London, Connecticut, in the year ending Dec. 31, 1856: *by* H. Hobart, *Collector of Customs.*

ARTICLES.	Amount shipped to foreign ports.	Valuation.
Apples, dried........................pounds....	11,602	$774
Bacon ....pounds....	15,758	1,921
Beef, salt ....barrels	2,966	35,243
Biscuit or ship-bread...............barrels	5,494	19,421
Butter........................pounds....	15,616	3,591
Candles, spermaceti ....pounds....	1,053	383
Cheese ....pounds....	2,627	331
Coal, anthracite...................tons	47	310
Cordage and cables...................tons	$64\frac{2}{5}$	25,925
Corn, shelled......................bushels	163	134
Corn-meal ....barrels	119	505
Earthenware	....	207
Flour ....barrels	1,721	14,360
Iron and its manufactures	....	53,221
Leather ....rolls	24	66
Lumber, pine........................feet	452,000	10,158
Marble, quarried........................	....	120
Molasses ....gallons....	18,101	7,869
Oil, linseed........................gallons....	952	994
Onions	....	203
Pickles	....	50
Pork ....barrels	2,466	40,316
Potatoes, common...................bushels	917	716
Rice ....barrels	79	1,013
Spirits of turpentine ....gallons....	550	247
Tar and pitch ....barrels....	78	262
Tobacco, chewing ....pounds....	17,084	2,946
Vinegar ....gallons....	9,395	968
Total	....	222,254

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from New York, in the year ending December 31, 1856: *by* HERMAN J. REDFIELD, *Collector of Customs.*

ARTICLES.		Am't shipped to foreign ports.	Valuation.
Apples	barrels	13,310	$63,527
Ashes, pot and pearl	tons	3,692	438,842
Bacon	pounds	31,548,393	3,030,337
Bark, oak			79,675
Bear skins			884,399
Beaver skins			
Beef, salt and dried			1,112,317
Beeswax	pounds	211,023	60,834
Biscuit or ship-bread	barrels or kegs	66,876	221,407
Bricks, common			24,079
Butter	pounds	1,528,851	287,004
Candles	pounds	1,625,390	277,398
Cattle	number	1,277	92,763
Cheese	pounds	6,415,230	598,135
Clover-seed			69,512
Coal	tons	19,500	97,181
Copper			182,739
Cordage and cables	pounds	982,900	123,143
Corn, shelled	bushels	4,060,187	2,938,763
Corn-meal	barrels	92,961	348,483
Cotton	bales	196,252	10,210,032
Cotton goods, printed or colored			146,170
Cotton goods, uncolored			1,757,013
Earthenware			14,673
Flax-seed	bushels	10,400	18,017
Flour	barrels	2,056,810	14,931,110
Ginseng	pounds	385,021	184,349
Hemp, common	pounds	29,300	2,529
Hides	number	5,914	27,583
Hogs, live	number	20	156
Hops	pounds	704,056	72,272
Horses	number	210	29,134
Iron, castings			42,925
Lard	pounds	13,275,876	1,551,040
Leather			84,368
Lumber	feet	24,673,000	501,561
Molasses	gallons	15,019	5,941
Mules	number	342	40,980
Oil, lard	gallons	56,486	54,054
Oil, linseed	gallons	37,626	35,296
Onions			26,992
Paint			77,613
Pork	tierces and barrels	138,285	2,589,199
Potatoes, common	bushels	24,489	64,011
Rice	barrels and tierces	40,464	940,507
Rosin	barrels	441,920	1,057,268
Rum	gallons	739,553	370,987
Rye			1,532,809
Rye-meal	barrels	9,696	44,262
Salt	bushels	16,700	5,528
Sheep and lambs	number	1,518	9,868
Snuff	pounds	20,187	2,497
Spirits of turpentine	gallons	1,265,585	537,820
Staves and heading	thousand	14,233	1,054,451

STATEMENT—Concluded.

Articles.		Am't shipped to foreign ports.	Valuation.
Sugar, cane	pounds	125,109	$10,390
Tallow	pounds	1,659,148	194,511
Tar and pitch	barrels	30,866	71,603
Tobacco, leaf	hogsheads	8,761	
Tobacco, strips	cases	4,154	1,359,434
Tobacco, stems	bales	9,949	
Tobacco, chewing	pounds	4,946,874	934,565
Vinegar	gallons	30,896	4,874
Wheat	bushels	10,554,165	16,518,759
Whiskey	gallons	337,801	205,929
Total			68,253,618

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from Oswego, New York, in the year ending December 31, 1856: *by* E. B. Talcot, *Collector of Customs.*

Articles.		Amount shipped to foreign ports.	Valuation.
Apples	barrels	608	$3,284
Bacon, in bulk	pounds	36,677	4,246
Butter	pounds	1,500	226
Candles	pounds	19,627	3,181
Cheese	pounds	42,095	4,627
Coal, anthracite	tons	25,489	181,925
Cordage and cables	pounds	458,000	6,141
Corn, shelled	bushels	54,621	31,751
Corn-meal	barrels	841	4,933
Cotton goods, printed or colored			230,322
Cotton goods, uncolored			877
Earthenware			2,705
Flour	barrels	22,659	159,567
Hides	number	16,690	61,404
Iron, pig	pounds	10,252,000	45,500
Iron, bar	pounds	1,635,312	58,686
Iron, castings			94,697
Leather	pounds	124,885	48,490
Lumber, pine	feet	370,100	2,459
Marble, quarried			49,782
Molasses	gallons	211,666	65,012
Onions	bushels	25	20
Pork	tierces and barrels	1,193	22,956
Potatoes, common	bushels	3,375	3,736
Rice	tierces	458	21,360
Rosin	barrels	1,977	20,072
Salt	bushels	450,037	140,199
Snuff	pounds	14,998	5,199
Tar and pitch	barrels	587	2,956
Vinegar	gallons	1,342	343
Wheat	bushels	221,752	274,698
Total			1,551,354

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from Perth Amboy, New Jersey, in the year ending December 31, 1856: *by* FRANK W. BRINLEY, *Collector of Customs.*

ARTICLES.	Amount conveyed coastwise.	Average prices.	Valuation.
Agricultural implements			$3,000
Apples ... barrels	11,041	$3 00	33,123
Apples, dried ... pounds	114,486	8	9,159
Beans ... bushels	1,648	1 50	2,472
Beeswax ... pounds	33,600	28	9,408
Binders' boards ... pounds	1,078,600	4	43,144
Blackberries ... quarts	106,400	6	6,384
Bricks, common ... number	13,000,000		58,500
Bricks, fire ... number	2,100,000	M 30 00	63,000
Brooms ... number	6,000	10	600
Buckwheat flour ... barrels	1,549	6 00	9,294
Butter ... pounds	1,738,210	20	347,642
Calves ... number	4,615	5 00	23,075
Carriages ... number	400	150 00	60,000
Cattle ... number	2,148	30 00	64,440
Catsup ... gallons	10,000	35	3,500
Cedar posts and rails	90,000		10,500
Charcoal ... bushels	2,500,000	8	200,000
Cheese ... pounds	20,000	9	1,800
Cherries ... quarts	11,000	6	660
Cherries, dried ... pounds	10,000	10	1,000
Cider ... barrels	5,776	4 50	25,992
Clay ... tons	20,000	1 00	20,000
Clothing, manufactured ... boxes	131	500 00	65,500
Cordage ... tons	600	250 00	150,000
Corn, shelled ... bushels	226,000	65	146,900
Corn-meal ... bags	158,116	1 50	237,174
Corn-meal feed ... bags	20,951	1 25	26,189
Cotton goods, unbleached ... yards	1,200,000	6	72,000
Cranberries ... bushels	2,400	4 00	9,600
Earthenware			20,000
Eggs ... dozen	37,155	15	5,573
Fish ... pounds	4,000,000	3	120,000
Flour ... barrels	930	6 50	6,045
Fowls ... number	320,096	20	64,019
Furniture, manufactured			140,000
Geese ... number	1,500	1 00	1,500
Grapes ... pounds	10,000	6	600
Hay ... tons	2,300	18 00	41,400
Hay-seed ... bushels	3,000	5 00	15,000
Hogs, dressed ... pounds	1,821,584	7	127,507
Hogs, live ... number	21,541	10 00	215,410
Homony ... bags	941	4 00	3,764
Honey ... pounds	1,500	10	150
Hoops and hoop-poles ... number	395,000		11,850
Horses ... number	1,344		171,900
India-rubber, canes, buttons, &c			80,000
India-rubber, boots and shoes	1,000,000	75	750,000
Iron, castings ... tons	4,500		737,900
Iron, pig ... tons	15,666	30 00	469,980
Lard ... pounds	150,000	10	15,000

STATEMENT—Concluded.

ARTICLES.	Amount conveyed coastwise.	Average prices.	Valuation.
Leather, sole ...pounds..	2,104,969	$0 30	$631,490
Lumber, cedar ...feet..	3,650,000	3	109,500
Lumber, chestnut poles, rails, and posts ...number..	18,800	...	2,000
Lumber, hemlock ...feet..	1,500,000	1½	22,500
Lumber, oak, pine, cedar, &c., used in building vessels ...	...	...	101,320
Lumber, pine ...feet..	450,000	2½	11,250
Lumber, oak piles ...	...	...	2,000
Marl ...tons..	1,000	2 00	2,000
Milk ...quarts..	12,500	4	500
Nuts, various kinds ...bushels..	3,391	1 75	5,934
Oakum ...pounds..	111,046	8	8,833
Oats ...bushels..	160,000	40	64,000
Oats ...bags..	51,103	1 00	51,103
Oil-cloths ...yards..	478,000	80	382,400
Oil, lubricating ...gallons..	30,158	1 20	36,189
Oysters ...bushels..	800,000	1 00	800,000
Oysters ...gallons..	40,000	1 00	40.000
Paper-hangings ...	...	...	204,155
Peaches ...baskets..	65,000	1 00	65,000
Plated ware ...	...	...	70,000
Plums ...bushels..	800	1 25	1,000
Potatoes, common ...bushels..	146,871	75	110,153
Poultry, dressed ...pounds..	1,809,724	13	235,264
Rye ...bushels..	4,200	1 00	4,200
Rye ...bags..	6,006	2 50	15,015
Rye-flour ...barrels..	600	5 00	3,000
Sand ...tons..	10,000	60	6,000
Shears, manufactured ...	...	...	50,000
Sheep and lambs ...number..	36,800	...	125,420
Slates ...cases..	1,350	8 00	10,800
Spokes ...	...	...	60,000
Strawberries ...quarts..	31,000	10	3,100
Turkeys ...number..	6,000	1 50	9,000
Veneering, sawed oak, cedar, maple, &c. ...	...	...	52,290
Wheat ...bushels..	9,000	1 50	13,500
Wheels, manufactured ...sets..	1,500	10 00	15,000
Whiskey or spirits from grain..gallons..	800,000	30	240,000
Whiskey ...barrels..	36,400	9 00	327,600
Whortleberries ...bushels..	10,000	2 50	25,000
Wine, manufactured ...gallons..	7,000	75	5,250
Wire ...pounds..	1,158,638	5	57,931
Wood, pine ...cords..	4,200	5 00	21,000
Wood, hard ...cords..	3,300	...	18,500
Wool ...pounds..	50,000	50	25,000
Total ...	...	...	9,330,905

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from Philadelphia, Pennsylvania, in the year ending December 31, 1856: *by* CHARLES BROWN, *Collector of Customs.*

ARTICLES.		Amount shipped to foreign ports	Valuation.
Alcohol	gallons	15,227	$10,630
Apples	barrels	3,546	11,456
Ashes, pot	tons	7	1,200
Bacon, hams	pounds	5,604,133	462,796
Bark, oak (quercitron)			70,699
Beef, salt	barrels	3,321	175,914
Beef, salt	tierces	4,043	
Beeswax	pounds	38,266	10,126
Biscuit or shipbread	barrels and kegs	26,375	72,788
Butter	pounds	411,794	76,517
Candles	pounds	650,485	91,851
Cheese	pounds	98,973	10,469
Clover-seed, white			100,012
Coal, anthracite	tons	13,599	60,402
Cordage and cables	pounds	34,832	4,233
Corn, shelled	bushels	1,094,255	737,186
Corn-meal	barrels	91,820	291,633
Cotton	bales	30	1,295
Cotton goods, printed or colored			43,607
Cotton goods, uncolored			36,290
Flour	barrels	345,811	2,418,392
Hops	pounds	2,483	260
Horses	number	2	290
Iron, pig	pounds	56,000	625
Iron manufactures of			368,768
Iron, nails	pounds	366,525	13,638
Lard	pounds	1,034,029	132,172
Lead, bar	pounds	39,926	2,997
Lumber, pine	M feet	1,580	28,135
Oil, lard	gallons	1,897	1,869
Oil, linseed	gallons	280	246
Onions	ropes	4,000	226
Pelts, sheep or lambs'	number	12	60
Pork	tierces and barrels	7,679	141,056
Potatoes, common	bushels	3,945	3,305
Rice	tierces	3,740	102,787
Rosin	barrels	13,187	26,040
Rye	bushels	232,363	214,940
Rye-meal	barrels	15,043	67,247
Salt	bushels	150	50
Snuff	pounds	5,813	1,407
Soap	pounds	1,688,939	71,176
Spirits of turpentine	gallons	15,031	6,524
Staves and heading	thousand	25	686
Tallow	pounds	373,753	45,707
Tar and pitch	barrels	803	1,954
Tobacco, leaf	pounds	379,400	41,825
Tobacco, chewing	pounds	123,118	17,209
Vinegar	gallons	61,939	6,613
Wheat	bushels	643,859	1,047,919
Wood, manufactures of			166,158
Total			7,199,385

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from Plattsburgh, New York, in the year ending December 31, 1856 : *by* HENRY B. SMITH, *Collector of Customs.*

ARTICLES.	Amount conveyed coastward by lake.	Amount conveyed coastward by railroad or by land.	Amount conveyed inland.	Total amount.	Average prices.	Valuation.
Apples .... barrels..	2,670	2,370	......	5,040	$2 50	$12,600
Apples, dried .... pounds..	....	2,500	......	2,500	6	150
Ashes, pot .... tons..	14½	48	......	62½	120 00	7,500
Ashes, pot .... pounds..	29,000	96,000	......	125,000	6	7,500
Ashes, pearl .... tons..	140	113	......	253	140 00	35,420
Ashes, pearl .... pounds.	280,000	226,000	......	506,000	7	35,420
Bacon, hams ..... hogsheads and tierces..	....	15	......	15	24 00	360
Bark, hemlock .... cords..	....	2,927	......	2,927	2 50	7,317
Barley .... bushels..	7,947	5,243	......	13,190	1 00	13,190
Beans .... bushels..	970	2,500	......	3,470	1 50	5,205
Bear skins (black) .... number..	10	....	......	10	4 50	45
Beeswax .... pounds..	400	868	......	1,268	25	327
Buckwheat .... bushels..	1,247	1,333	......	2,580	40	1,032
Butter .... pounds..	142,000	454,000	......	596,000	19	113,240
Butter .... firkins..	2,800	9,000	......	11,800	....	....
Calves .... number..	147	223	......	370	4 00	1,480
Cattle .... number..	117	1,947	1,876	3,940	30 00	118,200
Charcoal .... bushels..	....	80,000	......	80,000	7	5,600
Cheese .... pounds..	....	100,000	......	100,000	9	9,000
Cider .... barrels..	....	150	......	150	3 00	450
Eggs .... dozen..	....	42,000	......	42,000	14	5,880
Flax-seed .... bushels..	....	450	......	450	1 12½	506
Flour .... barrels..	....	2,190	......	2,190	6 00	13,140
Fowls, common .... number..	....	19,296	......	19,296	12½	2,412
Fox skins .... number..	....	294	......	294	1 50	441
Fox skins (cross) .... number..	....	29	......	29	3 00	87
Geese .... number..	....	2,190	......	2,190	40	876
Hay .... tons..	....	427	......	427	6 00	2,562
Hogs, live .... number..	....	715	......	715	4 00	2,860
Honey .... pounds..	....	1,750	......	1,750	12	210
Hoops .... thousand..	....	4,297	......	4,297	5 00	21,485
Hops .... pounds..	240,000	....	......	240,000	8	19,200
Horses .... number..	900	1,244	......	2,144	80 00	171,520
Iron, pig .... pounds..	10,501,125	....	......	10,501,125	1½	157,517
Iron, bar and bloom .... pounds..	35,376,605	....	......	35,376,605	....	....
Iron, castings .... tons..	127	....	......	127	80 00	10,160
Lard .... pounds..	....	31,916	......	31,916	10	3,192
Laths .... pieces..	31,300,000	....	......	31,300,000	M 1 70	53,210
Leather .... pounds..	102,979	113,791	......	216,770	26	56,360
Lumber, pine .... feet..	11,697,960	17,887,579	......	29,585,539	1½	443,783
Lumber, hemlock .... feet..	63,766,300	46,715,600	......	110,481,900	½	552,410
Lumber, maple .... feet..	97,670	37,930	......	135,600	1½	2,034
Lumber, cherry .... feet..	11,450	....	......	11,450	2	229
Martin skins .... number..	....	291	......	291	2 50	728
Mink skins .... number..	....	371	......	371	3 00	1,113
Oats .... bushels..	5,691	6,749	......	12,440	35	4,354
Oil, linseed .... gallons..	1,191	....	......	1,191	1 00	1,191
Peas .... bushels..	3,127	4,651	......	7,778	1 00	7,778
Pelts, sheep or lambs' .... number..	....	1,379	......	1,379	95	1,310
Pork, in bulk .... pounds..	....	37,981	......	37,981	7½	2,849
Potatoes, common .... bushels..	21,978	24,767	......	46,745	35	16,361
Rags, paper .... pounds..	14,721	13,972	......	28,693	5	1,435
Rye .... bushels..	14,791	7,247	......	22,038	70	15,427
Sheep and lambs .... number..	....	957	......	957	2 00	1,914
Staves and heading .... thousand..	579	59	......	818	5 00	4,090
Sugar, maple .... pounds..	3,970	....	......	3,970	10	397
Timothy-seed .... bushels..	....	2,797	......	2,797	3 00	8,391
Turkeys .... number..	....	24,971	......	24,971	50	12,485
Wool .... pounds..	29,450	27,479	......	56,929	34	19,356
Total	....	....	......	....	....	1,993,289

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from Providence, Rhode Island, in the year ending December 31, 1856: *by* GIDEON BRADFORD, *Collector of Customs.*

ARTICLES.	Number and quantity.	Valuation.
Beef ... barrels..	80	$1,170
Beer, ale, porter, and cider, in casks ... gallons..	100	9
Biscuit or ship bread ... barrels..	79	1,016
Biscuit or ship bread ... kegs and boxes..	362	
Boards, planks, and scantling ... M. feet..	512	7,479
Boots and shoes ... pairs..	436	499
Bricks, lime, and cement ...	...	96
Butter ... pounds..	907	239
Candles, adamantine, and others ... pounds..	400	40
Candles, spermaceti ... pounds..	2,240	851
Cheese ... pounds..	152	18
Copper and brass, and manufactures of ...	...	3,609
Corn, Indian ... bushels..	103	77
Corn-meal ... barrels..	11	50
Cotton, white, other than duck ...	...	194,829
Cotton, other manufactures of ...	...	17
Drugs and medicines ...	...	2
Flour ... barrels..	101	920
Furniture, household ...	...	112
Hams and bacon ... pounds..	1,495	222
Iron, manufactures of ...	...	26
Lard ... pounds..	400	26
Leather ... pounds..	50,000	7,250
Marble and stone, manufactures of ...	...	1,500
Musical instruments ...	...	2
Nails ... pounds..	75,100	2,899
Oil, whale, and other fish ... gallons..	2,477	2,028
Onions ...	...	1,866
Pork ... barrels..	37	660
Potatoes ... barrels..	3,183	3,601
Rosin and turpentine ... barrels..	657	1,385
Rye, oats, and other small grain and pulse ...	...	51
Shingles ... M. feet..	100	413
Soap ... pounds..	20,346	1,083
Tobacco, manufactures of ... pounds..	6,454	1,300
Wood, all other manufactures of ...	...	25,986
All other articles manufactured ...	...	455
All other articles raw ...	...	284
Total ...	...	262,070

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from St. Mark's, Florida, in the year ending December 31, 1856: *by* HUGH ARCHER, *Collector of Customs.*

ARTICLES.	Am't conveyed coastwise.	Average prices.	Valuation.
Cotton, Sea Island ......bales..	6,641	$65 00	$431,665 00
Cotton, Upland ......bales..	46,636	45 00	2,098,620 00
Cotton, osnaburgs......bales..	87	55 00	4,785 00
Cotton, yarn......bales..	742	36 00	26,712 00
Hides, dry ......bales..	56	100 00	5,600 00
Hides, dry, (unpacked) ......number..	6,785	2 50	16,962 00
Leather ......rolls..	16	30 00	480 00
Oil, rosin......barrels..	1,171	7 00	8,197 00
Oil, rosin ......casks..	14	35 00	490 00
Skins, deer......bales..	54	25 00	1,350 00
Skins, deer, (unpacked)......number..	1,562	25	390 50
Tallow......barrels..	11	25 00	275 00
Tar, pitch, &c. ......barrels..	434	2 50	1,085 00
Tobacco, leaf ......cases..	2,800	125 00	350,000 00
Turpentine, crude......barrels..	31	2 50	77 50
Turpentine, spirits of......barrels..	3,515	16 00	56,240 00
Varnish ......barrels..	11	20 00	220 00
Wax, bees'......barrels..	16	50 00	800 00
Wool......bales..	59	60 00	3,540 00
Total	......	......	3,007,489 00

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from Stonington, Connecticut, in the year ending December 31, 1856: *by* BENJAMIN F. STATES, *Collector of Customs.*

ARTICLES.	Am't conveyed coastwise.	Am't conveyed coastwise by railroad or by land.	Valuation.
Apples ......barrels..	1,000	......	$3,000
Beans ......bushels..	300	......	600
Beef, salt......barrels..	862	......	9,439
Biscuit or ship-bread ......barrels..	62,680	......	5,131
Butter ......pounds..	50,000	......	10,000
Calves......number..	400	......	1,200

STATEMENT—CONCLUDED.

ARTICLES.	Am't conveyed coastwise.	Am't conveyed coastwise by railroad or by land.	Valuation.
Cheese .... pounds..	....	100,000	$8,000
Cotton-goods .... yards..	....	900,000	54,000
Eggs	....	....	4,000
Flannel, woolen and cotton .... yards..	....	7,026,000	1,405,200
Geese .... number..	....	3,200	3,200
Leather .... rolls..	720	....	3,600
Peaches .... bushels..	500	....	375
Pelts, sheep or lambs' .... number..	....	1,200	600
Pork .... tierces and barrels..	563	....	10,158
Staves and heading .... number..	1,156,200	....	21,825
Turkeys .... number..	....	20,000	30,000
Vinegar .... gallons..	....	3,000	300
Total	....	....	1,570,628

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from Tampa Bay, Florida, in the year ending December 31, 1856: *by* HUGH ARCHER, *Collector of Customs.*

ARTICLES.	Am't conveyed coastwise.	Average prices.	Valuation.
Cabbages .... number..	500	$0 20	$100 00
Cattle .... number..	340	15 00	5,100 00
Cedar logs, red .... feet..	4,800	40	1,920 00
Cotton .... bales..	277	65 00	18,005 00
Fish .... barrels..	145	6 00	870 00
Hides, dry .... number..	1,757	2 50	4,392 50
Lumber, live-oak .... feet..	5,300	60	3,180 00
Lumber, pine .... feet..	35,000	1½	525 00
Molasses .... barrels..	350	10 00	3,500 00
Moss .... bales..	5	15 00	75 00
Palmetto logs .... number..	300	1 00	300 00
Potatoes .... barrels..	75	2 50	187 00
Skins, deer .... bales..	32	30 00	960 00
Skins, otter .... packages..	3	20 00	60 00
Sugar .... hogsheads..	308	60 00	18,480 00
Sugar .... barrels..	5	20 00	100 00
Wood .... cords..	1,010	3 50	3,535 00
Total	....	....	61,289 50

Statement of the quantity and estimated value of articles of merchandise, of domestic growth and manufacture, exported from Wilmington, North Carolina, in the year ending December 31, 1856: *by* James T. Miller, *Collector of Customs.*

ARTICLES.	Am't conveyed coastwise.	Amount shipped to foreign ports.	Total amount.	Average prices.	Valuation.
Beeswax.........hogsheads.	50	....	50	$200 00	$10,000
Coal.........tons.	16	....	16	4 00	64
Corn.........bushels.	10,750	....	10,750	65	6,987
Cotton.........bales.	21,256	96	21,352	45 00	960,840
Cotton, sheeting.........bales.	1,968	....	1,968	65 00	127,920
Cotton, warp.........bales.	200	....	200	45 00	9,000
Cotton, waste.........bales.	78	....	78	10 00	780
Cotton, yarn.........bales.	1,984	....	1,984	45 00	89,280
Eggs.........barrels.	9	....	9	20 00	180
Feathers.........bags.	316	....	316	25 00	7,900
Flax-seed.........bushels.	1,899	....	1,899	1 30	2,469
Flour.........barrels.	2,203	815	3,018	7 25	21,880
Fruit, dried.........barrels.	4,000	....	4,000	4 00	16,000
Furs.........hogsheads.	60	....	60	500 00	30,000
Hemp.........bales.	90	....	90	15 00	1,350
Hides, dry.........number.	13,084	....	13,084	2 00	26,168
Laths.........number.	....	50,500	50,500	M. 1 75	88
Lumber, pitch-pine.........feet.	10,776,523	10,774,211	21,550,734	M. 14 00	301,710
Masts.........number.	....	192	192	50 00	9,600
Moss.........bales.	6	....	6	5 00	30
Newspapers.........bundles.	3,877	....	3,877	5 00	19,385
Peas, cow.........bushels.	3,244	....	3,244	80	2,595
Peas, ground.........bushels.	76,240	23	76,263	1 30	99,142
Pitch.........barrels.	4,701	2,183	6,884	1 50	10,326
Rags.........bales.	137	....	137	12 00	1,644
Reeds.........bundles.	226	....	226	1 00	226
Rice, rough.........bushels.	112,868	14,685	127,553	1 00	127,553
Rice, clean.........casks.	388	273	661	16 00	10,576
Rosin.........barrels.	427,202	9,289	436,491	1 50	654,736
Shingles.........number.	43,549	4,873,500	4,917,049	M. 4 00	19,668
Soapstone.........tons	4	....	4	22 00	88
Spars.........number.	123	....	123	20 00	2,460
Spirits of turpentine.........barrels.	110,918	929	111,847	16 00	1,789,552
Spirits of turpentine, 5 gal. cans.	2,090	....	2,090	2 00	4,180
Staves.........number.	74,784	63,000	137,784	M. 12 00	1,653
Tar.........barrels.	56,635	6,954	63,589	1 60	101,742
Timber, pitch-pine.........feet.	219,441	611,000	830,441	M. 8 75	7,266
Tobacco.........boxes.	110	....	110	20 00	2,200
Tobacco.........hogsheads.	5	....	5	125 00	625
Tobacco.........bales.	83	....	83	30 00	2,490
Turpentine, crude.........barrels.	57,699	6,023	63,722	2 60	165,677
Varnish.........barrels.	43	....	43	12 00	516
Wheat.........bushels.	78,212	....	78,212	1 50	117,318
Wood, juniper.........cords.	698	....	698	8 00	5,584
Wool.........bales.	73	....	73	55 00	4,015
Total.........	....	....	....	....	4,773,463

ABSTRACT OF CENSUS RETURNS, *showing the population, agricultural statistics, number of cattle and hogs sold, and their value, and the value of domestic and general manufactures of the State of Iowa, for* 1856.—[Official.]

	INHABITANTS.								AGRICULTURAL STATISTICS.							
	No. of dwelling-houses.	Number of families.	Number of males.	Number of females.	Colored.	Total.	Married.	Owners of land.	Acres of improved land.	Acres of unimproved land.	Acres of meadow.	Tons of hay.	Bushels of grass-seed.	Acres of spring wheat.	Bushels of spring wheat harvested.	Acres of winter wheat.
Total.......	83,906	89,224	274,012	235,402	271	509,414	170,979	67,111	2,043,958	6,515,479	140,656	225,346	20,815	346,966	4,972,639	41,114

	AGRICULTURAL STATISTICS—Concluded.							HOGS AND CATTLE SOLD.				DOMESTIC MANUFACTURES.				
	Bushels of winter wheat harvested.	Acres of oats.	Bushels of oats harvested.	Acres of corn.	Bushels of corn harvested.	Acres of potatoes.	Bushels of potatoes harvested.	Number of hogs sold.	Value of hogs sold, in dollars.	Number of cattle sold.	Value of cattle sold, in dollars.	Pounds of butter made.	Pounds of cheese.	Pounds of wool.	Value of domestic manufactures, in dollars.	Value of general manufactures in dollars.
Total......	496,877	190,922	6,127,329	737,213	31,163,362	18,124	2,014,388	403,584	3,127,531	125,779	2,923,253	6,099,208	732,323	517,441	438,900	4,096,961

STATISTICS *of the manufactures of Lowell, Massachusetts, January* 1, 1857 : *Compiled from authentic sources.*

NAMES OF CORPORATIONS.	Merrimack Manufacturing Company.	Hamilton Manufacturing Company.	Appleton Company.	Lowell Manufacturing Company.	Middlesex Company.	Suffolk Manufacturing Company.	Tremont Mills.	Lawrence Manufacturing Company.	Lowell Bleachery.	Boott Cotton Mills.	Massachusetts Cotton Mills.	Lowell Machine Shop.	Total.
Capital stock	$2,500,000	$1,200,000	$600,000	$2,000,000	$1,000,000	$600,000	$600,000	$1,500,000	$300,000	$1,200,000	$1,800,000	$600,000	$13,900,000
Number of mills	*a*	*b*	Three	*c*	*d*	Three	Two.	Five	*e*	Five	Six.	*f*	Fifty-two
Spindles	81,000	48,512	18,920	*g*	16,340	21,986	20,448	58,624	....	51,936	58,512	....	394,144
Looms	2,300	1,382	700	*h*	*i*	750	760	1,822	....	1,430	1,891	....	11,889
Females employed	1,650	850	400	800	730	500	550	1,300	40	870	1,300	....	8,990
Males employed	750	400	120	500	575	150	130	390	260	*j* 262	400	550	4,197
Yards made per week	380,000	235,000	150,000	*k*	*l*	154,000	210,000	360,000	....	300,000	507,000	....	*m*
Pounds of cotton consumed per week	85,000	80,000	60,000	55,000	....	60,000	60,000	140,000	....	90,000	175,000	*n*	715,000
Pounds of wool consumed per week	....	....	....	66,000	25,000	....	....	....	....	....	....	....	91,000
Yards dyed and printed	340,000	*o*	....	....	....	....	....	....	*p*	....	....	....	470,000
Kind of goods made	*q*	*r*	*s*	*t*	*u*	*v*	*w*	*x*	....	*y*	*z*	*aa*	....
Tons of anthracite coal, per annum consumed	9,000	3,800	350	3,000	2,500	500	500	1,800	4,000	1,300	1,800	*bb*	29,850
Bushels of charcoal per annum consumed	6,000	3,000	1,000	2,000	500	1,600	400	3,000	....	1,800	2,000	12,000	33,300
Cords of wood per annum	400	130	....	....	300	30	....	120	100	70	10	200	1,360
Gallons of oil per annum	7,200	6,500	2,300	*cc*	*dd*	2,700	3,000	8,217	2,000	7,000	8,400	3,000	*ee*
Diameter of water-wheels	*ff*	*gg*	Five turbines	*hh*	12 and 17 ft.	Four turbines	*ii*	*jj*	....	*kk*	*ll*	*mm*	....
Length of water-wheels for each mill	Breast, 24 ft.	....	....	....	*nn*	....	....	*oo*	....	60 feet	60 feet	....	....
Pounds of starch per an.	190,000	120,000	90,000	....	....	100,000	75,000	190,000	400,000	190,000	220,000	....	1,575,000
Barrels of flour per an.	1,000	85	....	....	....	....	....	....	100	....	60	....	1,245

a Six, and print-works.
b Four, and print-works.
c One spinning, one carpet, one cotton.
d Four, and three dye-houses.
e Bleachery and dye-works.
f Four shops, smithy, and foundry.
g 7,016 wool, 8,050 cotton.
h 200 power carpet, 205 cotton, 49 fancy check.
i 200 broad-cloth, 200 narrow.
j Including mule-tenders.
k 25,000 yards carpet, 14,000 yards print-stuffs, 78,000 yards Osnaburgs, 50 rugs.
l 24,000 narrow, 6,000 broad cloth.
m 2,216,000 cotton, 30,000 woolen, 25,000 carpets, 50 rugs.
n 3,000 tons wrought and cast iron per annum.
o 112,000 printed, 18,000 dyed.
p 15,000,000 yards dyed per annum, 8,000,000 lbs. bleached per annum.
q Prints and sheetings, No. 25 to 40.
r Prints, flannels, ticks, and sheetings, 14 to 30.
s Sheetings and shirtings, No. 14.
t Carpets, rugs, cotton cloth, and pantaloon stuffs.
u Broad-cloth and doe-skins, cassimere shawls.
v Drillings, No. 14.
w Sheetings No. 14, shirtings No. 14.
x Drillings, printing cloths, sheetings and shirtings, 14 to 30.
y Drillings, No. 14; sheetings, No. 30; shirtings, jeans, printing cloth, do.
z Sheetings, 13; shirtings, 14; drillings, 14.
aa Cotton machinery, locomotives, machinists' tools, and mill-work.
bb 1,000 tons hard, 300 chaldrons soft.
cc Lard, 20,000; sperm, 8,000.
dd Sperm, 4,000.
ee 82,317 oil, 20,000 lard.
ff Four breast, 30 feet; six turbines, 5 feet; two do., 8 ft. 6 in.
gg Nine turbines, three breast wheels.
hh Three turbines, 7½ feet diameter; one do., 8 4-12 do.
ii Four turbines, 8 ft. 4 in. diameter.
jj Six turbines, 9 ft.; six breast, 17 ft.
kk Seventeen feet, and two centre vent-wheels, as improved by Mr. Francis, 9 ft. 4 in. diam.
ll Eighteen breast, 17 feet; four turbines.
mm Two turbines, 6 ft. 10 in. diam. each, and one breast-wheel, 13 ft. diam. by 13 feet long.
nn 23, 21, and 45 feet.
oo No. 5 mill, 80 feet

STATISTICS—CONCLUDED

Average wages of females, clear of board, per week	$2 00
Average wages of males, clear of board, per day	80
Medium produce of a loom, No. 14 yarn, yards per day	45
Medium produce of a loom, No. 30 yarn, yards per day	33
Average per spindle, yards per day	$1\frac{1}{4}$

The Middlesex Company make use annually of 2,000,000 teasels, 1,200,000 pounds fine wool, 20,000 pounds glue, $15,000 worth dye stuffs, and $13,000 worth of soap.

In addition to the above, the Merrimack Manufacturing Company use 1,000,000 pounds of madder, 380,000 pounds copperas, 60,000 pounds alum, 50,000 pounds sumach, 40,000 pounds soap, 45,000 pounds indigo, per annum.

The Lowell Bleachery use 40,000 pounds indigo, and $30,000 worth of other dyeing materials per year.

Other manufactures are produced in the city than those specified above, of a value of $1,500,000, employing a capital of $400,000, and about 1,500 hands.

There are six banks—The Lowell, capital $200,000; The Railroad, capital $600,000; The Appleton, capital $200,000; The Prescott, capital $200,000; The Wamesit, capital $150,000; The Merchants', capital 100,000.

The population of Lowell, in 1828, was 3,532; in 1840 it was 20,796; in 1850 it was 33,385. Increase in ten years, 12,589. In 1855 it was 37,553.

There are three institutions for savings—the Lowell, the City, and the Five Cent Savings Bank. The Lowell had on deposit, November 4, 1856, from 5,716 depositors, $1,140,338 93. The City, January 12, 1856, had on deposit, from 3,949 depositors, $1,007.9~9 22. The Five Cent Savings Bank went into operation in June, 1854, and on December 6, 1856, the amount of deposits was $220,966 53, from 2,228 depositors. The operatives in the mills are the principal depositors in the above banks.

A vast amount of laudable and successful enterprise, of a more strictly private character, might be appropriately alluded to here, not the least of which are the paper and batting mills, carried on by the heirs of Mr. Perez O. Richmond, and the flannel mills of Mr. Charles Stott, all on the Concord River, within the precincts of the city. Messrs. Fiske & Norcross' extensive lumber-yard and saw-mills, and the Wamesit Steam Mills, are also worthy of notice.

The proprietors of the locks and canals on Merrimack River, incorporated in 1792, are the owners and managers of the water-power. They have leased to the manufacturing companies water power amounting in the aggregate to about 10,000 horse-power. The stock in this company is owned by the manufacturing companies, in the same proportions in which they hold the water-power; the rents paid are only sufficient to pay the expenses of management and maintenance of the power. This company carry on the Burnettizing process, by which timber is rendered more durable. From one to two millions of feet are prepared by them annually. They also keep up a staff of engineers, for purposes connected with the use and distribution of the water-power.

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